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The Financial Structure and Performance of the Salmon Farming Industry in Canada

Economic and Commercial Analysis Report N° 94

Fisheries and Oceans
Pêches et Océans

Canada

The Financial Structure and Performance of the Salmon Farming Industry in Canada

Commercial and Market Analysis Division

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Department of Fisheries and Oceans

The Financial Structure and Performance of the Salmon Farming Industry in Canada

Executive Summary

The federal Department of Fisheries and Oceans commissioned Price Waterhouse to assess the financial structure and performance of the salmon farming industry in Canada as compared with the industry in Norway, Chile and Scotland. The report is based on an extensive literature review of publicly available data, interviews with government officials, industry specialists and representatives from the salmon farming industry in both Canada and overseas.

The report examines the financial structure and performance of the salmon farming industry in Western and Eastern Canada, and in Norway, Chile and Scotland in light of falling world salmon prices. The concluding chapters assess the strengths and weaknesses of the Canadian industry in the context of salmon farming development in other countries. They identify efficient and effective approaches to future industry development in Canada.

Salmon Farming in Western Canada

The industry in British Columbia grew very quickly after its foundation in the late 1970s and its growth and development was largely unconstrained by governments. The industry quickly became under funded as a result of its rapid growth. Financing problems typical to new businesses were compounded by a shortage of government financial support and by a failure on the part of British Columbia commercial banks to provide sufficient capital. The British Columbia industry grew on injections of foreign investment from Norwegian banks and thus developed a very high debt/equity ratio.

With existing gluts on world salmon markets, the capital budgets of British Columbia salmon farmers have therefore been squeezed: high debt repayments and very low reserves caused many operators to go out of business. The result has been substantial rationalization and retrenchment with some 23 receiverships over the last two years.

Producers in British Columbia have also been squeezed on the operating side. West coast producers have concentrated on growing indigenous species, namely coho and chinook rather than Atlantic salmon. However, Pacific salmon have higher food conversion ratios, they grow more slowly and are smaller in size than Atlantics, therefore commanding lower prices. Concentration on Pacific species has partly resulted from government regulations which severely restricted the cultivation of Atlantic salmon on the British Columbia coast (founded in a concern for the impact of a non-indigenous species on natural Pacific stocks). These are now being amended and production of Atlantic salmon is increasing. However, in general, the government in British Columbia is perceived to have had a regulatory approach to industry development, not because they have imposed more regulations than in other countries but because their regulations have been directed at influencing the activities of individual producers.

Marketing activities have not been prevalent in British Columbia. Though individual producers have attempted to market their own product and attempts have been made to develop a strategy, there has been relatively little implementation of a generic campaign to sell British Columbia farmed salmon. To date efforts to implement a campaign have been hampered by a lack of funding. More recently, increasing attention has been paid to marketing in the face of growing world competition. In an increasingly competitive world market, the development of a campaign will be essential to establish and maintain a market share. The British Columbia industry has the advantage of being close to a large potential market in the US which can be expanded and cultivated.

Some of the above problems will have to be solved if the industry is to realize its full potential and capitalize on its major natural advantages like a virtually unlimited number of suitable sites and excellent water conditions. Many can be solved by analyzing the experience of other salmon producing countries.

Salmon Farming in Eastern Canada

Salmon farming on the Atlantic coast has developed more steadily than in British Columbia. In that region, provincial governments restricted the growth of the industry through regulatory measures and in doing so prevented some of the growing pains experienced in the West. Also, provincial governments in Eastern Canada provided a significant amount of financial, and research and development support as did the federal government through the Atlantic Canada Opportunities Agency. Commercial banks also have played an important role in providing start-up capital and both capital and operating loans. This contrasts with the unwillingness of commercial banks in British Columbia to lend to salmon farm operators. Further research is required to explain these differences.

Because of this relatively slow, orderly growth, the structure of the Atlantic industry reflects that seen in Norway and Scotland. There are a number of smaller operators but there is also a considerable degree of vertical concentration and cooperation at the post-harvest processing level.

A further advantage has been the concentration on Atlantic salmon. Despite the relative youth of the industry and the problems created by dramatic increases in salmon production, the Atlantic industry has been able to maintain relatively large margins by farming larger salmon which sell for higher prices and using fewer resources in doing so.

The salmon farming industry on the Atlantic coast does not have the same potential for expansion as the industry in British Columbia. The number of potential sites is restricted and water temperatures and quality are not as conducive to salmon farming. The industry is, however, well-structured and has the potential to support a number of coastal communities. As is the case in British Columbia, a large, relatively undeveloped US market is on the doorstep and the Atlantic industry will need to design a targeted marketing campaign to establish a niche for its product.

Key Features of Overseas Industries

World production of farmed salmon has grown dramatically over the past few years, from approximately 46,500 million tonnes in 1985 to 68,000 tonnes in 1986, 86,500 tonnes in 1987, 139,500 tonnes in 1988 and to some 210,000 tonnes in 1989. In the last two to three years, salmon prices worldwide dropped significantly partly as a result of these higher production levels, to the tune of 30 - 40% based on industry price data for Norway, Canada and Chile. Production is expected to have increased further to 270,000 tonnes in 1990 but salmon prices have stabilized somewhat.

Farmed salmon production worldwide is dominated by Norway with Scotland, Japan and Chile also playing a major part. However, since Japan is a major importer of salmon, our analysis of overseas industries concentrates on Norway, Chile and Scotland.

In Norway, salmon farming is well-established and important lessons can be learned from the Norwegian experiences.

- The Norwegian government has played a crucial role in financially supporting salmon farming and, in regulating the industry, thus determining the structure and nature of the industry.
- As a result of government support, salmon farmers have not been forced to build up high debt/equity ratios.
- Atlantic salmon have been farmed throughout the history of the industry and a wealth of research and experience has therefore been established. A large research and development support sector also exists.
- Concentration on Atlantic salmon allows Norwegian producers to reduce their relative cost of production and to sell their product in higher price brackets.
- A high degree of vertical integration and cooperation has reduced post harvest and processing costs to a minimum.

- The government and the FFSO (the Norwegian central marketing agency) have developed campaigns to market Norwegian salmon and have begun to research value-added products. These activities are proving increasingly important as competition on world salmon markets increases. They have also been instrumental in controlling output over the last year in an effort to maintain salmon prices at a constant and reasonably high level.

The Chilean salmon farming industry is not as established as the industry in Norway but it is characterised by a number of very distinctive and interesting features.

- The hands-off approach of the government (keeping taxes low and keeping regulation to a minimum) has encouraged a high degree of foreign investment and has allowed operators a high degree of freedom in developing their operations.
- Government has played an important role in providing financial and research and development support. It has provided both credit and loan guarantees.
- Chile has a relative advantage in cheap labour. Capital development has therefore been relatively low as producers have concentrated on labour intensive operation. Operators have therefore managed to keep their costs of production as low as any other country, despite having to import most salmon eggs and fry, capital equipment and feed.
- Though Chilean producers have concentrated heavily on coho salmon in the past, they are now realizing the advantages of Atlantic production and have moved very fast towards increased production of Atlantics.
- Chile has developed a distinct market share in Japan and the US as a result of aggressive marketing.

The Scottish industry has more in common with Norway than Chile. Many of the lessons to be learned from Norway also apply to Scotland. However, the following characteristics are distinctive to Scotland.

- Government support has been instrumental in the development and continued growth of the industry. A substantial amount of financial support for operations and for marketing has been made available.
- Operators are beginning to realize the potential of decentralized operation. A number of the larger companies are beginning to decentralize their operations in order to achieve improved operating efficiency.
- There is a high degree of organization among Scottish operators which has ensured cooperation on processing functions. Economies of scale at the processing level have therefore been significant. There is also a relatively high degree of vertical integration in the industry.
- Costs of production, as in Norway, differ substantially between regions in Scotland. It would appear that costs are much lower in the Shetlands where farm size has remained small.
- The marketing boards operating on the Mainland and the Shetlands have been aggressive in encouraging development of value-added products and the expansion of domestic markets. There has also been a concentration of effort and funding on the development of a generic campaign to market Scottish salmon.

The report concludes that there are several areas in which a careful analysis of experience in salmon farming elsewhere in the world could prove useful to the Canadian salmon farming industry.

- The Canadian industry should pay attention to the structural experiences of Norway and Scotland where there appear to be very few economies of scale at the operational level: smaller operators seem to be as efficient as larger ones.
- Considerable economies of scale exist at the post harvest processing and marketing level. Vertical integration has therefore proved successful. This type of integration also ensures security of supply and services. Where integration has not taken place, cooperation between producers and processors has achieved the same effects.
- If the industry is to develop in a controlled and sustainable way, some government funding and the establishment of regulations which control but do not inhibit operating freedom, are essential. This is especially true if a certain type of industrial structure is desired.
- A careful analysis of the profitability of farming different species needs to be carried out to establish methods of improving productivity and widening profit margins. At this time, Atlantic salmon appear to be farmed at a greater profit than Pacifics.
- In an increasingly competitive world market, the establishment of a niche for salmon and salmon products is becoming important. Most other countries spend significantly more on generic marketing campaigns and on the development of a variety of value-added products.
- A direct comparison of operating and capital costs is very difficult given available data. However, costs seem easier to manage and minimise in smaller operations. Costs are also lowest if post-harvesting costs are kept to a minimum and if production concentrates on Atlantics rather than Pacifics.

In conclusion, it appears that the financial structure and performance of the industry has been more controlled and sustainable in Eastern Canada than in British Columbia. Though production levels in the East remain below those in the West, the structure of the industry is stronger and the performance of individual producers has been superior. The main reasons for this are carefully monitored and regulated growth, and commercial and governmental financial support to the new industry.

The salmon farming industry in Western Canada has grown too rapidly and in an uncontrolled fashion. Consequently, there are a number of structural problems in the industry which will need to be solved over the next few years. The current rationalization/concentration in the British Columbia industry would appear to be beneficial in this respect, encouraging economies of scale in marketing and supply, and elimination of inefficient producers. However, the industries on the two coasts also have substantial similarities which, in the longer term, will help to strengthen their position: both are located close to a major US market with significant potential for expansion, they have suitable sites and water quality for salmon farming and both are in the process of developing generic marketing campaigns to ensure a niche for their product in the American market.

Introduction

World production of farmed salmon has grown dramatically over the past few years: from approximately 46,500 million tonnes in 1985, to 68,000 tonnes in 1986, 86,500 tonnes in 1987, 139,500 tonnes in 1988 and some 210,000 tonnes in 1989 (see appendix 1). Production is expected to increase further to 270,000 in 1990.

A major consequence of increasing production levels has been the reduction in world salmon prices, consistent world prices for farmed salmon are difficult to obtain, but industry estimates indicate the extent of the price drop in selected countries. Data from the B.C. Salmon Farmers' Association based on Urner-Barry Seafoods statistics show that prices for 4-6 lb Norwegian Atlantics rose to a peak of $US 5.3/lb in June 1987 but fell throughout 1988 and 1989 to a low of around $US 3.0/lb in December 1989, a drop of 43%. Prices for Norwegian Atlantics rose slightly in 1990, similar trends were experienced in other regions. For example, 4-6 lb B.C. chinook reached a price of $US 4.5/lb in April 1987 but fell to $US 2.4/lb in September 1989, a 47% drop. More detailed price data are presented in appendix 1-2.

Salmon farmers in Canada are experiencing financial difficulties due to falling prices, high levels of debt, high interest rates, unfavourable exchange rates, and an increase in the world supply of salmon. A number of farms have recently gone into or are on the verge of, receivership. On the Pacific coast, prices have been near or below production costs and farmers have been forced into selling small salmon to meet cash requirements. Some of the more solid farming companies have taken over weaker farms or farms that have gone bankrupt. In some cases, government assistance has been sought to help farmers deal with immediate financial problems.

Previous studies indicate that there is considerable potential for expansion of salmon farming in Canada. Some of the reasons for this include:

- valued domestic species available for culture;
- large areas of environment suitable for culture activities;
- broad experience in aquaculture;
- a technically-oriented society; and
- a broad experience in fisheries research in many of the sciences required as a technical base for culture.

Against this are a number of negative factors such as:

- fierce competition;
- harsh climate, including low temperatures; and
- high cost of doing business.

The purpose of this study is to examine the historical development of the salmon farming industry in Canada and its current performance in order to provide insights into how Canadian salmon farmers can improve their performance. This is done by reviewing the Canadian industry on both coasts and comparing it with its counterpart in major competing countries.

World production of farmed salmon has been dominated by Norway with Scotland and Japan also playing a major part. Between them, they produced about 80% of the world supply of farmed salmon in 1989. The industry in Norway and Scotland is older than that in Canada and has passed through more advanced stages of development. Our review of industry performance in these two countries is therefore instructive as it provides clues as to the possible development path of salmon farming in Canada and suggests pitfalls which might be avoided.

Japan is a net importer of salmon and therefore, though it is also a large producer, it has not been included as a major focus in this report. Instead, the report examines the development and performance of the Chilean salmon farming industry as a third comparative example. The salmon farming industry is relatively new in Chile and, though it operates under production characteristics which differ from those in Canada, it does provide some useful insights into possible development paths for the Canadian industry.

Through our comparative examination of the salmon farming industry in Norway, Scotland and Chile, this report identifies the major strengths and weaknesses of the Canadian industry in the face of increasing world competition and falling salmon prices. The report concludes by identifying those areas where proactive change will be most likely to improve the performance of salmon farming on both Canadian coasts.

Salmon Farming in Western Canada

Historical Development

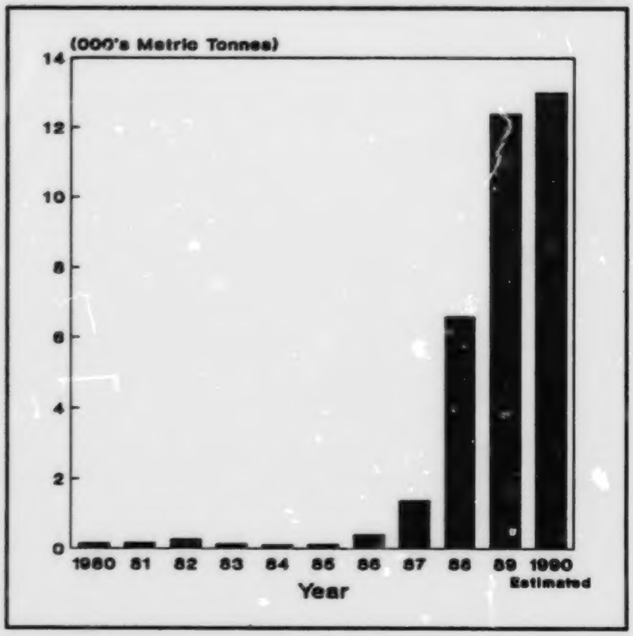
Salmon farming began in British Columbia in 1972. The first farm was established on the Sechelt Peninsula, a region in southern coastal British Columbia northwest of Vancouver. By the mid 1980s nearly half of the British Columbia aquaculture industry was located there.

Most of the early attempts to raise salmon were unsuccessful for a variety of reasons. Among these were high mortality rates, limited financing and technical problems in rearing mostly pan-sized coho. These pioneering efforts at farming Pacific salmon provided the experience necessary for subsequent growth of the industry in the 1980s when British Columbia witnessed an explosive growth in salmon farming. Operating farms increased from 10 in 1984 to 135 in 1988. To keep pace with the demand for smolts, ten new hatcheries were established over the period, bringing the total to 46 by 1988. From 1988, to June of 1990 there were 23 receiverships and bankruptcies (9 occurring from January to April 1990), leaving approximately 52 companies operating at some 106 sites. Rationalization was also seen among hatcheries with the total number of operating sites falling from 46 in 1988 to 26 in December 1989.

Production levels which were only 100-200 tonnes from 1979 to 1985, increased to approximately 1,350 tonnes in 1987 and to almost 12,400 tonnes valued at $85 million (farm gate value) in 1989. Increases in 1988/89 were achieved in spite of an algae bloom of Heterosigma and Chaetoceros which swept through the waters of the Agamemnon Channel and Jervis Inlet. Losses from this bloom were estimated at $2,000,000, about 2% of British Columbia annual farmed production. A summary of production since 1980 is shown in the chart below (see also appendix 2):

Salmon Production in British Columbia
1980 - 1990

Chart 1



Market opportunities combined with natural conditions favourable to salmon farming on a large number of potential farm locations, have contributed to British Columbia's position as an emerging leader in salmon production. In 1989, British Columbia's level of salmon production was surpassed only by that of Japan, Scotland and Norway. It is expected that by 1995, farmed salmon production capacity will reach 40,000 tonnes. Actual production will likely range between 20,000 and 30,000 tonnes.

On the other hand, though the British Columbia salmon farming industry has grown rapidly to become fourth largest in the world, the industry remains small when compared to salmon farming in Norway. In a span of about 15 years, farmed salmon production in Norway increased from about 100 tonnes in 1971 to 117,000 tonnes in 1989 or about 140% of the entire catch of British Columbia wild salmon.

The growth of the industry was accompanied by the launch of several federal and provincial initiatives. In the summer of 1987, the Minister of Agriculture and Fisheries established the Aquaculture Industry Advisory Council and the Industry Advisory Committee. The purpose of the Committee is to obtain expert guidance and advice from representatives of the industry regarding aquaculture development which can be made available to farm operators. The Council is a cross-sectoral body and its purpose is to place the aquaculture industry in the context of the overall development and use of coastal resources.

At the Aquaculture International Conference in September 1988 the federal and provincial governments signed a Memorandum of Understanding. The purpose was to facilitate cooperation from both levels of government through joint regulation, research, extension, and marketing.

Industry Structure

Marine Grow-Out Operations

The salmon farming industry in British Columbia is characterized by farms which raise salmon to market size in net pens in salt water. With this system, nets are sewn in a bag-like configuration and suspended from floating support structures. With land-based and sea-based closed farming systems, fish are grown in tanks or bag-like structures which are installed on land or at sea. Water is circulated using pumps and generators. These systems are expected to yield lower mortality rates and to create a disease-free, controlled environment but with higher capital investment.

About 135 finfish sites were in operation at the end of 1988. By June 1990 the number of sites had decreased to 106. (B.C. Ministry of Agriculture and Fisheries)

At the present time, all operating sites in British Columbia are around Vancouver Island and on the Sunshine Coast. As of January, 1990, only seven licensed sites were located in the Prince Rupert North Coast Region, 68 were on the Sunshine Coast/Lower Mainland Region, and the balance or 138 (10 leased and 128 licensed sites) were on Vancouver Island. Nevertheless, there are still available sites suitable for farmed salmon production, particularly on the Northwest coast of Vancouver Island (33 investigative permits issued).

The number of sites available is limited by a lack of access and infrastructure. This restriction tends to be of a more temporary nature than the biophysical problems experienced elsewhere in the world, and climatic complications: infrastructural deficiencies can be and are being addressed and solved over time as the industry develops.

With experience it is also emerging that some areas are less suitable for culture than originally thought. The Sechelt area which saw the early expansion of the industry has experienced serious problems from algae blooms and the focus of the industry is moving to the Northeast and West coasts of Vancouver Island.

A widespread algae bloom occurred throughout the Sunshine Coast area in August and September 1989. The bloom should have the effect of hastening the current shift away from sites in the Sunshine Coast to areas around Campbell River, North Island, and West Coast of Vancouver Island.

Average farm size in British Columbia (in terms of pen volume) is approximately 28,000 M^3 compared with a maximum allowable farm size of 12,000 M^3 in Norway. However, this comparison is misleading. Stocking densities average between 20 and 25 kg/M^3 in Norway as compared with planned stocking densities of 4-8 kg/M^3 in British Columbia: the low densities in British Columbia are attributable to the fact that Pacific salmon have much lower stocking densities than Atlantic salmon. Assuming a stocking density of between 6 and 8 kg/M^3 in British Columbia, the average farm holding capacity will therefore range from 196,000 kg (196 tonnes) and 224,000 kg (224 tonnes). This compares with 240,000 kg (240 tonnes) to 300,000 kg (300 tonnes) in Norway.

The above estimates yield a total holding capacity of 24,000 tonnes (2.4 million kg) for the industry. However, maximum licensed capacity is estimated to be greater than this at some 39,000 tonnes (December 1989). Licensed capacity is based upon a firm's anticipated full capacity as stated on licence application forms. Actual production will therefore fall below this figure as the firm will take several years to reach full capacity. Furthermore, in any one year only one class of fish will be harvested of a number of classes held.

Production in 1989 at approximately 12,400 tonnes was less than the forecast of 13,000 tonnes. 1989 production was valued at $85 million based on an average selling price of $6/kg. It is expected that 1990 production will be some 13,000 tonnes, valued at $90 million.

The actual farm holding capacity was 30,000 tonnes in 1989 and is estimated to be 24,000 tonnes (based on 106 operating farms and an average farm capacity of between 200 and 240 tonnes). Fish production is still low relative to capacity because of the lead time required for salmon to reach marketable size. Also, existing farms do not normally stock at capacity during start-up since operating capital is often limited. Although the number of sites in 1990 has dropped to around 106, the impact on industry production will not be significant given that all existing operating sites have spare capacity and production levels can be increased. Furthermore, though there have been a number of receiverships in the industry, the capital stock established has not been taken out of production but has shifted to new owners and remains in production.

Hatcheries

In 1988, 46 hatcheries were operating in British Columbia. By 1990, this figure had fallen to 26 with a total smolt production capacity of 17 million smolts. Smolt production in 1989 was 29 million.

The industry is now self-sufficient in egg supply. Smolt production in 1989 considerably exceeded the previous year's total. A survey of hatcheries in the fall of 1989 by the B.C. Salmon Farmers Association confirmed that 25 million smolts were stocked. This stocking level fell beneath the overall production of smolts (29 million) leading to an excess of smolt supply over demand of 4 million. In 1989, 24.4 million chinook (84%), 3.1 million coho (11%) and 1.7 million Atlantic smolts (5%) were produced.

Major Company Profiles

Latest estimates suggest that in 1990 there are approximately eight large operating companies with production in excess of 500 tonnes, and about 43 smaller operations at every stage of development.

The number of large operators fell by one in the spring of 1990 when Aquarius Seafarms Ltd., the largest salmon farming company in the province went into receivership, though its farms are now being operated by Hardy Seafarms Ltd. The company's sole business was salmon farming and processing. Its majority owner was Aqua Technology & Investment A/S of Bergen, Norway. Aquarius operated 12 grow-out sites, a hatchery, and a processing plant, which were all located on the Sunshine Coast. It had a marketing agreement with Clouston Foods, a major food distributor with a network throughout North America. Clouston Foods was recently purchased by Fisheries Products International of St. John's Newfoundland. The company reared mostly chinook, with some coho production. 1989 production was estimated at about 2,000 tonnes.

B.C. Packers Ltd., the province's largest integrated seafood company, currently operates six grow-out sites which it has purchased at discounted prices. The company also transports, processes and markets farmed salmon. It sourced, processed and controlled about 35% of British Columbia production in 1988, mostly from sourced production. In 1989, B.C. Packers bought out the British Columbia assets of Clearwater, a Halifax-based company. These assets included a one-third interest in a hatchery on Vancouver Island and three grow-out sites in the North Island. B.C. Packers parent company is the Weston Group which is directing most new investment in the industry to Connors Brothers Ltd., its subsidiary located in New Brunswick.

General Sea Harvest Corporation's main business is salmon farming. Its majority owner is Cultor A/S, the Finnish-based parent of Ewos (Canada) Ltd., one of the two major fish feed companies in the province. The company operates a total of 11 grow-out sites: nine in the Tofino area and two in the Campbell River area. It has an interest in another site located in Indian Arm. It owns a hatchery in Barclay Sound with a production capacity exceeding one million smolts and has an interest in a harvesting and processing company in Tofino. It also owns a scallop hatchery near Qualicum on Vancouver Island. The company is rearing mostly chinook, with some coho production. Production in 1988 was about 200 tonnes and 1989 production approximately 500 tonnes. 1990 production is estimated to be 825 tonnes. The company does its own marketing through a recently created sales and marketing arm, Seaprime Seafood Ltd.

Hardy Seafarms Ltd.'s main business is salmon farming. The company is owned by Bergen Seafoods (Norway) which also now own the assets of Aquarius, operated by Hardy Seafarms. Hardy Seafarms has seven grow-out sites, all located around Hardy Island on the Sunshine Coast. It also owns a hatchery on Vancouver Island which has a production capacity of 1.2 million smolts. The company is rearing chinook salmon, with some limited coho production. On acquiring the assets of Aquarius, a further 12 grow-out sites and 1 hatchery (with a production capacity of 5 million fry) were added to Hardy's operating capacity.

IBEC Aquaculture's sole business is salmon farming. Its owner is Arbour Acres Inc., a chicken and turkey broiler producer based in Connecticut. Arbour Acres in turn is owned by Booker McConnell, a large U.K.-based firm which owns a major salmon farming company in Scotland. The company currently operates five grow-out sites and a hatchery in North Island. The company is rearing both Atlantic and chinook salmon. Production in 1988 was about 100 tonnes and forecasted production in 1989 was about 500 tonnes. Its hatchery has a production capacity of 3-3.5 million smolts and the company should be producing some 4,000 tonnes by 1992. They are expected to be a dominant firm in the industry and favour the rearing of Atlantic salmon over Pacific.

Pacific Aqua Foods Ltd. produces both salmon and oysters. Its majority owner is National Sea Products Ltd., Canada's largest seafood company. The company has seven salmon grow- out sites and four hatcheries, two of which are jointly owned by other companies. Six of the seven grow-out sites and three of the hatcheries are in Campbell River and the North Island area , while the remaining grow-out site and hatchery are on the Sunshine Coast. The company also sources production from other farms. The company's marketing is partially integrated with the National Sea distribution network in North America. They produce both Atlantic and chinook salmon. 1988 was a rebuilding year for the company and it had minimum salmon sales. Production in 1989 was estimated at 500 tonnes.

Pacific National Group operates a number of sites on the West Coast of Vancouver Island in the Tofino area (see the Pacific National Group profile in the Eastern Canada section for more information). The group is financed with tax-sheltered venture capital. As a result, it has minimal debt and is one of the most soundly based companies in British Columbia.

SeaFarm Canada is operated as a joint venture between Sea Farm Norway and Canada Packers. It has operations on both coasts. In British Columbia it has one hatchery and has partial ownership of another, as well as 5 grow-out sites. It also markets its own product. The company is dedicated to the production of Atlantic salmon.

Concentration

The British Columbia salmon farming industry is currently undergoing a consolidation and rationalization of existing companies. The price decline in 1989 precipitated many of the receiverships. High start-up costs and accumulated debt load left many companies extremely vulnerable to any price decline particularly one as large and sudden as the one experienced in 1989/90. The recent consolidation is seen as a redistribution of assets within the industry as larger companies become more involved. This has resulted in fewer companies controlling larger shares in industry production, and a reduction of the number of operating companies in the industry from 75 in 1989 to 52 in June 1990.

Integration

There is a high degree of vertical integration in the British Columbia industry, with eight companies producing about 70% of the industry's total production.

Integration is common at the farm level. Although the pattern of integration is unsettled, the large firms are commonly integrated from broodstock into grow-out and even some processing. However, most firms are not integrated forward into processing. The traditional packing industry has substantial under-utilized capacity during the commercial fishery off-season.

Foreign Investment

A primary reason for substantial expansion in British Columbia is successful Norwegian investment. The strict regulatory environment in Norway has led many firms to invest in British Columbia. Norwegian enterprises that have invested in British Columbia are large relative to the capital requirements in aquaculture. Some of these firms have exhausted investment opportunities in Norway in that regulations preclude them from entering or expanding into specific aquaculture activities. A

1988 study reported that approximately 60-70% of all investments in the British Columbia industry at that time involved Norwegian interests.

Government Regulation and Support

The provincial Ministry of Agriculture and Fisheries, Aquaculture and Commercial Fisheries branch, is the lead ministry responsible for aquaculture development in British Columbia. The Ministry has recently consolidated licensing procedures. Under new regulations effective at the end of 1989, a single aquaculture licence is used for both registration of an aquaculture enterprise and operation of the facility. Developed with input from both industry and other levels of government, the streamlined procedures reduce the number of government agencies involved in licensing, establish standard criteria, and provide a framework for guidelines and controls. The licensing system is self-financing, with fees charged to recover the costs of administration.

The Chinook Broodstock Program is coordinated by the B.C. Ministry of Agriculture and Fisheries to evaluate the production potential of various wild salmon stocks in a number of geographical areas. The program will assist British Columbia farmers to concentrate on strains suitable for cultivation in their particular area. In developing wild salmon stocks, the Salmonid Enhancement Program (SEP) also assisted in creating an understanding of the hatching process for salmon. This expertise is directly transferable to the salmon farming industry and has facilitated the development of private hatcheries.

Control of species has been a major area of provincial regulation. Concerned with the impact on indigenous Pacific species, the provincial and federal governments have closely controlled the import of Atlantic eggs and fry into the province. This has limited production levels of the species. However, research is beginning to show that the environmental impact of Atlantic farming in the west is unlikely to be negative. Regulations on imports of Atlantic smolts and eggs are therefore diminishing, as is evidenced by production data for Atlantic salmon, though only limited quantities of smolts and eggs have been imported to date and these have primarily been for broodstock programs.

The Ministry of Crown Lands issues the leases and licences of occupancy for fish farms. They also conduct Coastal Resource Identification Studies which identify degrees of aquaculture acceptability and suitability in the context of resource competition.

From 1989, the environmental impacts of salmon farms have been controlled under a waste monitoring program. The Environmental Monitoring Program was developed by (and is administered by) the Ministry of Environment, in conjunction with the B.C. Salmon Farmers Association. As of December 1990, compliance with essential environmental monitoring criteria had been increased considerably over 1989. The industry still views elements of the program as unnecessary in the light of the limited and localized environmental impacts of salmon aquaculture.

Federal fish inspection regulations set out requirements for processing plant operations and finfish aquaculture. Public health inspectors from the provincial Ministry of Health further protect consumers by providing inspection services at the retail outlet level.

The Aquaculture Division of Fisheries and Oceans Canada Pacific Region is responsible for research in support of aquaculture, liaison and for co-operative projects with the provincial government, universities, industry and local associations. The emphasis is on Pacific salmon, mainly chinook and coho. Work is divided between the West Vancouver Laboratory on the mainland and the Pacific Biological Station at Nanaimo, British Columbia with experimental hatcheries and grow-out facilities at Rosewall Creek on Vancouver Island, the Cultus Lake Laboratory and a facility on Brandon Island adjacent to the Pacific Biological Station. The research on finfish at the West Vancouver Laboratory places emphasis on salmon genetics, broodstock development, and fish nutrition. At Nanaimo, the emphasis is on finfish husbandry, exploratory research on potential species for aquaculture, and fish health.

Industry Associations

The B.C. Salmon Farmers Association is the lead industry agency representing 30 salmon farming companies and hatcheries in the province. The Association also represents supply and service sector companies with large interests in the industry.

The B.C. Aquaculture Research and Development Council was formed in 1989 to promote future growth of the Aquaculture industry. Funded by the Science Council of B.C. and the B.C. Ministry of Agriculture and Fisheries, the new agency will play a lead role in identifying research needs and establishing research priorities. The agency is ultimately to be self-sustaining with finance provided from within the industry.

Support Sectors

The rapid growth in the aquaculture industry has spawned similar growth in the supply sector for aquaculture operators. A study by the B.C. Salmon Farmers Association indicated that the sector more than doubled in size from 1986 to 1987. As the supply sector grew so did the need for a representative organization and in 1988, the Canadian Aquaculture Suppliers Association (CASA) was incorporated.

More recently, the supply sector has been adversely impacted by the declining fortunes of a number of operators in the aquaculture industry. The decline in world prices and the rationalisation of the aquaculture industry impacted on the supply sector.

Canadian Aquaculture supply companies are also affected by continued import of supplies by aquaculture companies. Over the past four years, the local supply industry has developed to a stage where it supplies the vast majority of the industry's needs but several significant areas of supply still exist where levels of imports remain relatively high: 20% of netpens, 17% of feeders and feeder systems (including some feed), 17% of antibiotics, and 28% of insurance services, are still imported from Norway, Europe and the US.

Under a joint initiative of the Ministries of Agriculture and Fisheries and Advanced Education and Job Training, funding was provided for two aquaculture resource centres in British Columbia. These are located in prime aquaculture activity areas, namely Sechelt and Campbell River. The centres operate in association with Capilano College on the Sunshine Coast and North Island College on Vancouver Island.

A wide variety of short courses, workshops, and seminars on salmon farming are offered throughout the year at over ten locations around the province. In addition, several universities and colleges offer degree and diploma courses. These include the University of British Columbia, Simon Fraser University, University of Victoria, Malaspina College, Northwest Community College, North Island College, and Capilano College.

One of the largest research activities underway in the province has been launched by a private company, Ewos of Surrey, British Columbia. Located on Denman Island in the Strait of Georgia, the 20 pen, $1.5 million facility will be used primarily for research into nutrition for Pacific salmon.

Products and Markets

The Product

Most farms in British Columbia produce both chinook and coho salmon. However, the production of chinook salmon is more profitable than the production of coho and they comprise a larger proportion of total output. The industry has also experienced difficulties in rearing coho to marketable sizes within a consistent time frame as experiments undertaken to grow neutered coho were largely unsuccessful. However it should be noted that the lifecycle of coho is shorter than that of chinook so that coho can generate a positive cash flow faster than chinook.

Production of Atlantic salmon is growing in Western Canada. Figures produced by the B.C. Salmon Farmers Association show that British Columbia production of Atlantics has risen from zero in 1987 to an estimated 1,600 tonnes in 1990. This contrasts with 1990 chinook and coho production of 10,100 tonnes and 1,100 tonnes respectively. In 1990, chinook production is expected to comprise some 78% of total farmed output, Atlantic salmon will account for about 13% of farmed salmon production, and coho for 9%. The remaining 1% comprises salmon trout. Atlantic has thus overtaken coho as the second most cultivated species (B.C. Salmon Farmers Association).

There are several important characteristics of Atlantic salmon farmed in Norway and Eastern Canada, which make Atlantic salmon farming more suitable given the state of current world markets for salmon:

- survival rates of Atlantics after smoltification are high;
- Atlantic salmon can tolerate greater densities in sea pens than can chinook or coho. Pacific salmon have proved to require densities of 4 to 8 kg/M^3 compared to around 20 kg/M^3 with Atlantic salmon; and
- Atlantic salmon can be grown to and can be harvested at much larger sizes and therefore have lower unit costs of production than Pacific salmon. Larger salmon can also be sold in the higher price brackets.

The table below shows the production of salmon by size in Western Canada.

Table 1

Production of Salmon by Size in Western Canada
1988 - 1989

Size Class	**% Pacific**(1)	**% Atlantic**
< 2	5.9	-
2-4	34.0	11
4-6	40.0	22
6 +	20.0	67

Note:

(1) Includes chinook and coho salmon

Source: British Columbia Salmon Farmers Association

Given that the vast majority of British Columbia farmed salmon comprises chinook and coho, it is obvious that production is concentrated on smaller sized fish which have a lower market value and higher unit production cost that larger sizes. The average chinook size for the period November 1988 - December 1989 was 4.7 lbs contrasting with 7.2 lbs for Atlantics. In 1990, the average size for Atlantic salmon was 9.0 lbs, while chinook sizes remained relatively stable.

The companies rearing Atlantic salmon seem to favour this species over Pacific salmon for the reasons above. However, the industry is now rearing Pacific salmon successfully though it continues to search for ways to lower mortality rates, increase rearing densities and the size of the final product, and improve production characteristics. Most companies are also committed to chinook broodstock programs and this is expected to be the dominant species for at least the next five years. A number of companies are developing Atlantic salmon production and are expanding capacity for Atlantic smolts: IBEC, Pacific Aqua Foods Ltd., Sea Farm Canada and Nor-Am.. The first Atlantic salmon eggs were imported into British Columbia in 1984 and 1988 was the first year that Atlantic broodstock were in place.

Prices

Salmon prices worldwide have been sensitive to supply changes and increased competition on world markets. For example, between 1986 and 1987, farmed salmon prices increased, partly reflecting the lower catch of wild salmon. Between 1987 and 1989, salmon prices dropped by at least 30 - 40% due to increasing world supplies, not just from salmon farming but also from a record catch of Alaska salmon. Downward pressure on world prices is also said to have been encouraged by the dramatic increase in Norwegian farmed salmon production in 1989 and excessive numbers of sellers in the market place. (See price information in appendix 1-2).

Several factors have been cited as contributing to lower salmon prices including, among others, an increase in world farmed salmon production, high frozen salmon inventories in Japan and unfavourable exchange rates in some markets. Perhaps the most significant, however, was the 1989 staggering Alaskan salmon harvest. Reaching a new record of 152 million fish compared to only 100 million landed in 1988, Alaska's huge harvest undoubtedly contributed to the general decline in salmon prices. The sale of significant volumes of farmed salmon during the spring and summer months when low prices prevailed caused considerable hardship for B.C's salmon farming industry. Other local factors such as poor marketing and a preponderance of fish in small sizes also had an impact: financial pressures can cause the product to be brought to market earlier, aggravating conditions of over supply particularly of smaller fish, which are sold at much lower unit prices than larger fish.

Salmon prices will continue to face downward pressures over the next decade as production of farmed salmon is expected to increase. On the other hand, the high production quality and consistent supply of farmed salmon could put upward pressures on prices. Furthermore, 1989 and 1990 have been bonus years for the wild fishery and, as wild catches are highly cyclical, they can be expected to fall somewhat in subsequent years. In any event, marketing will play an increasingly important role in salmon farming. To gain a share of the increasingly competitive salmon market, the farmed salmon industry will have to capitalize on its ability to give consumers a consistent supply of fresh, high quality product. Close proximity to markets and new market initiatives such as value-added processing will become increasingly important as competition increases.

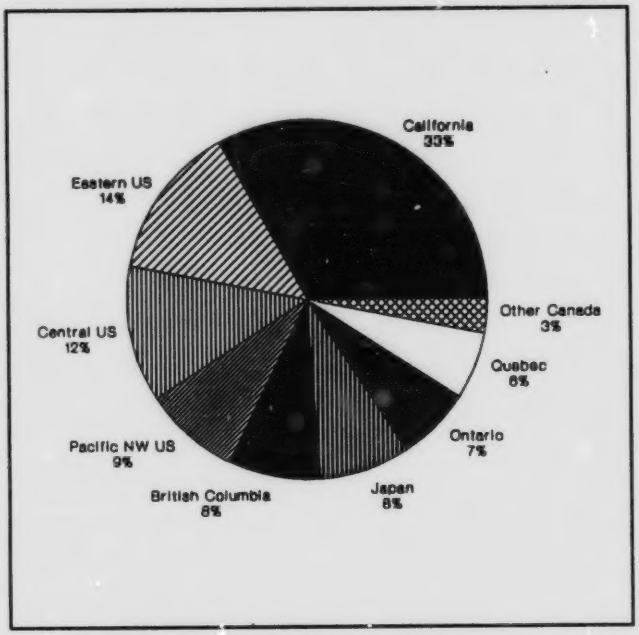
The Market

In 1990, there will be approximately 270,000 tonnes of farmed salmon delivered to world markets, 13,000 tonnes of which is estimated to originate in British Columbia.

The market for fresh British Columbia salmon continues to be primarily the United States and Canada, particularly the West coast. One of the key strengths of the British Columbia industry is its close proximity to a market with great potential for expansion, which it can supply at relatively low transportation costs. However, the Pacific rim countries could present a strong market for both fresh and frozen products in the future. The following chart shows current market destinations of British Columbia farmed salmon.

Market Destination of British Columbia Salmon
1990

Chart 2



Source: B.C. Salmon Farmers Association. "Current Developments in World Farmed Salmon".

Salmon farmers in British Columbia have been selling their product through a six-city United States distribution network that was geared to an annual three month wild fishery. The distribution network is yet to adjust fully to the opportunities offered by farmed salmon in terms of year-round availability.

Salmon prices generally drop on the West coast when the wild harvest begins in May off the Washington, Oregon and California coasts. As the industry gets further into summer, supplies of all salmon increase as Alaska's and British Columbia's wild harvests get into full swing. Thus, marketers see no prospect for any strength in the salmon market generally during spring and summer months.

Marketing Activities

Although the industry has been preoccupied with production related problems, it is clear that one of the primary challenges for the British Columbia industry is to develop new marketing strategies. Currently, the majority of British Columbia salmon is sold through large traditional fish processors (45%) and Canadian-based seafood brokers (20%). A further 20% is sold to foreign importers and the remainder goes to other Canadian wholesalers, restaurants, retailers or smokers. Few individual producers have the resources to finance market development activities themselves. The B.C. Salmon Farmers Association and government agencies are currently providing initiatives for generic market promotion. The long term objective is to build an image for all British Columbia seafood, both farmed and wild, of very high quality ensured by rigorous quality assurance programs and guarantees of purity.

To ensure that farmed fish products reaching consumers continue to be fresh, and of the highest quality, the B.C. Salmon Farmers Association have developed a new regulatory framework which provides voluntary inspection standards for British Columbia farmed salmon. External appearance, internal temperature, belly wall condition, scale loss, colour and odour will all be measured. Established in 1989 and funded by federal and provincial governments, inspections are carried out at various points in the distribution system, from processing plant to the marketplace. The world's largest independent control and inspection company has been retained to carry out the program. Salmon meeting the standards will receive a "Quality Approved" seal of excellence.

Competition

Marketers on both coasts focused efforts on seafood trade shows in February and March, 1989 (SeaFare'89 in Long Beach and Boston Seafood Show). However, like the market itself, the shows are very competitive, with the strongest competition coming from Norwegian salmon marketers. In the world market, British Columbia faces competition from all major producers, competition which will grow as world production increases. On the west coast of North America, it is likely that producers in British Columbia will come into particularly strong, direct competition with Chilean producers. In the same region, salmon farmers in British Columbia also compete with wild salmon during the summer fishing season, and with other wild fresh fish during the rest of the year.

Economic Performance

The decline in prices in 1989 has wiped out any potential profits for all but a few farms. There is a possibility that only four or five large companies out of the existing eight large operators, will remain after 1990. The companies with the best chance of survival are those with little or no debt and with committed investors behind them. Two of the largest salmon farm companies have recently gone into receivership: Royal Pacific Seafarms in 1989 and Aquarius Seafarms in 1990. From 1988 to-date there have been 23 receiverships.

Problems have arisen as a result of rapid expansion without regard to factors such as volume and production costs, and the huge commercial Pacific salmon fishery. In the mid 80s investors and entrepreneurs saw salmon farming as a gold mine. This Klondike mentality was therefore problematic for several companies and personnel. This attitude diminished in 1989 with the large number of receiverships that occurred, leaving only those companies really committed to the industry's future.

Costs of Production

Defining precise average costs of production, applicable to all operators, is an impossible task: operating costs will differ according to location of site, scale of operation, costs of inputs and the efficiency of their utilization, the degree of automation, mortality rates, etc. According to a study by Lee, unit costs are most sensitive to the following factors: salmon growth rates, product price, feed price, food conversion ratios, mortality rates and processing costs. The following section therefore provides a summary of cost information as calculated by the B.C. Ministry of Agriculture and Fisheries following a survey of a small group of producers in the Campbell River area of British Columbia in June 1989 with an update completed in July 1990. The scenario provided is an indication of operating costs for a particular firm on a given date rather than a representation of an actual or optimal industry operating costs. However, the percentage distribution of costs between various items is an important indicator and the cost schedules can provide a useful guideline to other operators when differences in operating conditions are taken into account.

Information available shows that there was a significant variation in production costs between June 1989 and July 1990. Unit costs of production fell from $7.058 to $6.513. These estimates are based upon the following assumptions:

- a 30% mortality rate;
- total net water volume of 72,000 M^3
- an average stocking density of 4.43 kg/M^3 and a maximum stocking density of 6 kg/M^3;
- a feed conversion ratio of 2.33 kg of feed to 1 kg if fish dressed;
- average farm labour of 4.5 full-time equivalents;
- weighted average price of $7.12/kg (1989) and $7.49 (1990).

Note: These assumptions differ slightly from those on pages 6 and 7. The figures used on pages 6 and 7 are industry averages used by the Ministry of Agriculture and Fisheries in their calculations.

The following table provides information on unit costs for an aquaculture operator.

Table 2

Costs of Production on a Chinook Salmon Farm in the Campbell River Area, British Columbia
June 1989 and July 1990

	June 1989		July 1990	
	Unit Cost/ kg ($)	%	Unit Cost/ kg ($)	%
Smolts	0.375	5.3	0.351	5.6
Feed(1)	3.142	44.5	2.647	42.3
Labour	0.546	7.7	0.546	8.7
Insurance	0.146	2.1	0.137	2.2
Transport/Marketing	1.992	28.2	1.882	30.1
Repairs and Maintenance	-	-	0.07	1.1
Fuel	-	-	0.042	0.7
Veterinary/Medicine	0.083	1.2	0.067	1.1
Miscellaneous Administration	0.34	4.8	0.898	1.6
Depreciation	0.435	6.2	0.418	6.6
Total	$7.059	100 %	$6.258	100 %

Notes: Unit costs/kg are based upon final sales of dressed fish of 239,573 kg.
Percentages are calculated using total operating costs plus depreciation.
FOB Vancouver.

(1) Includes feed delivery costs

Source: Ministry of Agriculture and Fisheries, Victoria, British Columbia

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The table shows that, on average, some 42-45% of operating costs are dedicated to feed and feed delivery, while a further 28-30% goes to transportation and marketing of the final product. This figure is high because a large proportion of salmon is live-hauled long distances from the farm to processing plants in the Lower Mainland. Interestingly, the unit cost figure of $7.056 corresponds with unit cost estimates in a February 1989 study by Spence and Egan who quote a figure of $7.06. The Spence and Egan study also found a similar breakdown of costs: 43% feed, and 31% processing and marketing.

The original study and its update show that from June 1989 to July 1990, there was a fall in operating costs, as a result of a reduction in average feed prices. Figures published in The Fish Farm News in April 1989 suggest that the B.C. Ministry of Agriculture and Fisheries figures are reasonable. The Fish Farm article states that on average, some 44% of costs are allocated to feed and feed delivery, while 21% goes to marketing and transportation. Initial results from a financial study of the aquaculture industry by Coopers and Lybrand also show that feed costs comprise the largest operating expenditure. Coopers and Lybrand calculate that some 40% of operating expenditures went to feed while a further 13% was dedicated to harvesting and processing. (No figures are available for transportation.)

The demonstrated fall in operating costs appears to have had a positive impact on returns earned in the industry. Returns rose from $1.7 million in June 1989 to $1.8 million in July 1990. With the fall in operating costs over the same period, net income rose from $13,600 (0.8% of total returns) to $282,500 (18.7%).

Capital Costs

The available literature contains very little data on capital costs in the aquaculture industry. Those that are available were collected by the B.C. Ministry of Agriculture and Fisheries in their survey of salmon farmers in the Campbell River Area. As with operating costs, the schedules shown below should not be taken as a standard or average but as an indicator of the conditions prevailing in the industry among smaller sized firms at a specific point in time. They can be used as a guideline by those in the industry.

The update of the original B.C. Ministry of Agriculture and Fisheries study in July 1990, shows the following capital investment items for a Campbell River salmon farm:

Table 3

Capital Investment Costs on a Chinook Salmon Farm in the Campbell River area of British Columbia
July 1990

Capital Investment Items	Replacement Cost ($)	%
Nets	163,600	11.4
Seacage system	388,800	27.1
Moorings	40,000	2.8
House and storage bldg.	80,000	5.6
Boats and motors	40,000	2.8
Other machinery and equipment	74,500	5.2
Salmon stock	645,186	45.1
Total	$1,432,086	100 %

Source: Ministry of Agriculture and Fisheries, Victoria, British Columbia

The table demonstrates that a significant proportion of investment is tied up in salmon stocks and working capital.

Given these investment items and the operating assumptions presented in the previous section, ratios can be produced as examples of measures which could be useful in planning salmon farming operations which are similar to those of firms included in the B.C. Ministry of Agriculture and Fisheries study:

- Total Investment required per tonne of dressed fish sold: $3,454
- Total Investment per full-time equivalent employee: $184,022
- Net and Seacage investment per total investment: $0.72

These measures are a small sample of those produced in the B.C. Ministry of Agriculture and Fisheries report on chinook salmon farming in the Campbell River area. The report produces a very comprehensive list of ratios which would be useful to salmon farmers and should be referred to by interested parties. More recently, the spate of receiverships in the British Columbia industry has reduced the cost of resale capital investment items, thus lowering one time start-up costs where such assets are available.

Financing

The salmon farming industry is in a state of crisis as far as funding is concerned. Given the poor performance of the aquaculture industry over the last few years, Canadian commercial banks are not prepared to lend to the industry. When looking at potential loans, bankers are concerned not only with the assets to offset a loan but also with the profitability of the company, its assets and the potential of the assets should the business go into receivership. On all these criteria, many companies in the aquaculture industry currently appear weak. At the same time, it must be remembered that the B.C. salmon farming industry in British Columbia is a new one, still in its start-up research and development phase. From this perspective, the bank's reluctance to invest is understandable.

The Vancouver Stock Exchange (VSE) which played a role in raising capital in the initial establishment of salmon farming, has since dried up as a source of financing. The exact role played by the VSE is still a point of conjecture. Some see it as a positive force in providing a new industry with liquidity, while others view it as negative, creating unrealistic expectations. Whichever view is correct, the VSE now plays a very minor role: only 5 of 52 companies are now listed on the exchange and it is no longer a viable source of funds.

Companies able to secure funding are those with sufficient assets to put up against a loan, where funds can flow through Canadian banks using securities owned by another business or individual as collateral. Larger operations forming part of a chain of businesses, or firms with access to individuals with large personal resources, are therefore more able to secure financing than those with assets in a single aquaculture operation. One of the primary forms of financing available, even to larger firms, has been the Norwegian banks which operate in British Columbia and this has led to the high debt-equity ratio which currently exists among salmon farmers in the province.

The government programs which provide financial assistance to the industry contribute primarily to capital expenditures. At the provincial level, the Agriculture Credit Act (under the Loan Guarantee Program) and the Small Business Venture Capital Program provide loan guarantees for a selected number of industry sectors, including aquaculture. At the federal level, the Western Diversification Fund provides support to aquaculture farms although on a selected basis. Despite these programs, direct financial assistance from government to British Columbia salmon farms has constituted a relatively small proportion of capital employed in the industry since 1985 and is virtually non-existent compared to government support of the salmon farming industry in other regions and countries. The attitude of aquaculture firms to government financing is defined by the size of the firm. Smaller firms tend to welcome government support. On the other hand, larger firms tend to take the position that the market should determine the survivors in the industry and that government support to prop up unviable businesses should be minimal.

Industry Outlook

It is expected that more rationalization will occur before the industry stabilizes. The number of large firms will probably reduce to some 4-5 while the number of small operators is indeterminate. The firms which survive are likely to be those with substantial assets in other sectors and with "deep pockets".

The actual performance of the industry over the coming years will ultimately depend upon world prices. These will remain volatile as a result of the fact that salmon is essentially a traded commodity. There will, however, be moves to strengthen operations in areas which can be controlled by the operator:

- efforts will be made to develop specific markets; and
- research and development will lead to new operating techniques which will help to reduce operating costs to a viable level comparable to those faced by international competitors.

Though the number of operators in the industry will fall, it is unlikely that production will decrease. It will probably stabilize for several years at around 12,000-15,000 tonnes as a result of rationalization and market competition. For the most part, however, industry capacity can support substantially higher production than has already been achieved. During the current rationalization of the industry, assets have not been removed from the industry but have been reorganized in a more efficient way. Production is therefore likely to increase in the longer term. A Price Waterhouse report on the Outlook of the Aquaculture Industry (1990) presented the following scenario for development of the salmon farming industry in British Columbia to the year 2000: "The British Columbia salmon industry will probably achieve a production rate of between 30,000 and 60,000 tonnes by the year 2000. The number of sites operating in British Columbia is expected to range between 175 and 300 direct employment is likely to be between 1,050 and 1,800. This excludes considerable indirect employment which will result from industries supplying the industry such as hatcheries, equipment manufacturers, processing plants, and feed suppliers."

Strengths and Weaknesses

Strengths of the Industry

- British Columbia is close to the United States, one of the largest potential markets for farmed salmon;
- The province has a great potential for protected farm sites without having to resort to expensive off-shore culture techniques;

- The waters off the British Columbia coast tend to be warmer than those of Norway which promotes faster fish growth;
- The British Columbia industry is bolstered by a strong support sector; and
- The British Columbia industry has developed significant production potential in the face of competition from a number of established producers, and the British Columbia wild fishery.

Weaknesses in the Industry

- Production levels of farmed salmon in British Columbia have been affected by high mortality rates due to algae blooms, disease, and other biophysical factors associated with raising previously undomesticated Pacific salmon species;
- Salmon farming in British Columbia is still at a developmental stage, requiring ongoing research;
- Salmon farmers in British Columbia have to compete with a large commercial fishery for market share and with a recreational fishing industry and environmental groups for government support and media attention;
- Though production costs appear to be lower than those incurred in mainland Scotland and Northern Norway, they are higher than production costs in the Shetlands, Atlantic Canada, Chile and most of Norway. The main reason for this is that British Columbia producers have substantially higher post-harvest costs than most other producers;
- Western Canada has not yet implemented a strong generic marketing campaign to market its product though one is currently being developed;
- British Columbia products are increasingly competing with those from Chile, produced at lower unit costs, in spite of relatively high transportation costs in Chile;
- Production in British Columbia has concentrated on chinook salmon which grow to smaller sizes, have higher post-smolt mortality rates and are sold at lower prices than Atlantics;
- The industry is relatively heavily regulated in its operational and locational decisions, by the government. For example, producers have been constrained from farming Atlantic salmon by government regulations aimed at controlling the introduction of new species to British Columbia waters;
- There are very few sources of finance available to the salmon farmer. Indigenous, British Columbian banks in particular have been disinclined to lend to salmon farms; and
- The industry as a whole has a high debt/equity ratio as a result of extensive investment of Norwegian Banks in British Columbia salmon farms.

Salmon Farming in Eastern Canada

Historical Development

The Maritime provinces have seen a rapid expansion in farmed salmon production in the last decade. Having produced only a few tonnes of Atlantic salmon in 1978, the region has now expanded to produce over 4,500 tonnes in 1989. Activity in this industry is being further diversified with hatcheries, equipment suppliers, feed manufacturers and processing facilities, some producing value-added products such as smoked salmon.

The development of the industry on the Atlantic coast contrasts sharply with that on the Pacific coast. The British Columbia industry has been heavily promoted while the Atlantic industry has developed quietly and steadily. While the Pacific industry has involved public companies and venture capital, the Atlantic industry has developed through a combination of small and large companies, more conventional financing and assistance from government agencies.

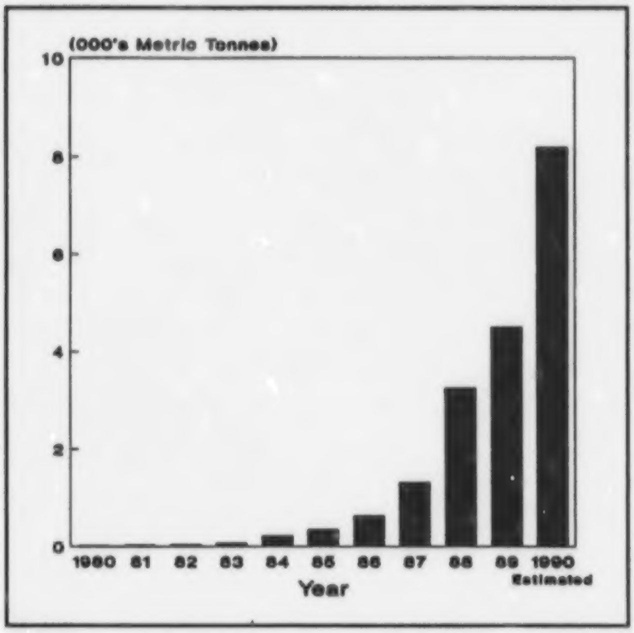
New Brunswick

Eastern Canada's first commercial sea cage salmon farm was established in 1978 on the outer coast of Deer Island in the Fundy Isles region in the Southwestern Bay of Fundy. With technical expertise and funding from the federal and New Brunswick governments, and equity invested by a private company, 3,800 salmon smolts were placed in a 12-meter octagonal cage similar to those used in Norway. The following autumn, 6.3 tonnes of Atlantic salmon were harvested.

Salmon production in New Brunswick increased from 6.3 tonnes to more than 220 tonnes between 1979 and 1984 (roughly doubling its harvest each year), the value jumping from about $49,000 to $2.5 million. In 1979 there was one commercial salmon farm operating in New Brunswick. By 1984 five farms were raising salmon. The industry entered a rapid growth phase in 1985, increasing to 18 farms, and then to 28 in 1986. By 1987 there were 33 licensed salmon farms in the Fundy Isles region, and a harvest of 1,300 tonnes and a value of $18 million. In 1987, that production had increased to 1,300 tonnes, worth $18 million, from a total of 33 farms operating in the Bay of Fundy area. By 1989 the number of farms had increased to 49, with production of 4,500 tonnes. Production in 1990 is forecast to be 8,100 tonnes from 52 farm sites (see appendix 3). The New Brunswick industry is estimated to employ roughly 400 persons directly, and an additional 1,000 in support and service industries.

Salmon Production in New Brunswick
1980 - 1990

Chart 3



In 1986, in the face of a number of pressures, the New Brunswick government placed a moratorium on new cage site development. The moratorium was intended to control the growth of marine sites to a rate consistent with the availability of smolts, and to ensure that the industry expanded in an orderly and rational fashion. The moratorium was lifted in December of 1988, following the introduction of a new Aquaculture Act.

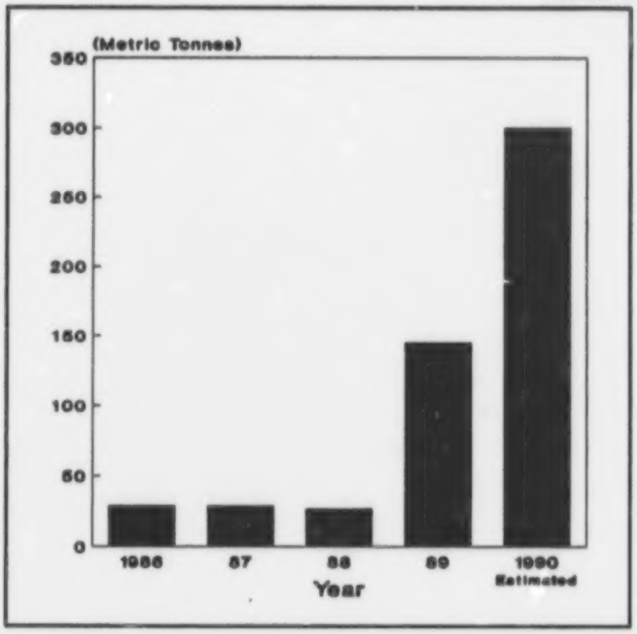
Nova Scotia

The Nova Scotia salmon farming industry started in the mid-1960s when a private company, Seapool Fisheries, attempted land based salmonid culture at Clam Bay on the Eastern Shore in Halifax County. This operation about five years, and was not economically successful. It was around this time that the Nova Scotia Department of Fisheries became involved in research and development projects in support of private sector aquaculture development.

Production in Nova Scotia was 29 tonnes in 1986 rising by 400% to reach 145 tonnes in 1989, valued at approximately $1 million (see appendix 4). However, this represents only 2% of the production level expected in New Brunswick. Production in 1990 is projected, by the Nova Scotia Department of Fisheries, to be 300 tonnes.

Salmon Production in Nova Scotia
1986 - 1990

Chart 4



From the mid-1960s to 1984 there was considerable government activity in technical aquaculture projects and efforts by private sector operators in Nova Scotia to establish salmon farms. From 1972 to 1982, Cape Breton Marine Farming, a subsidiary of the crown agency DEVCO (Cape Breton Development Corporation) was established to develop the technology, skills and markets to support finfish and shellfish aquaculture by the private sector.

Reacting to the absence of policies, legislation, lead-agency responsibility and financial support for the developing aquaculture industry, the Aquaculture Association of Nova Scotia presented a brief to the provincial and federal governments in 1979. A model for an Aquaculture Act and Regulations was subsequently developed in 1982. A Memorandum of Understanding (M.O.U.) between the province and the federal government was reached in 1986 which established provincial jurisdiction over sites, and responsibility for site licensing. The M.O.U. also created an Aquaculture Coordinating Committee to formulate a strategy for the development of aquaculture in Nova Scotia. A preliminary development plan for future support, encouragement and direction of private sector aquaculture in the Province was completed early in 1990 and formed the basis for more detailed planning activities now underway.

Industry Structure

New Brunswick

The New Brunswick salmon farming industry is concentrated in the Bay of Fundy region of Southwestern New Brunswick. The Bay of Fundy has extremely high tides which provide good water exchange for grow-out sites. The coastline of the mainland of the Province, and the larger islands such as Deer Island, Campobello and Grand Manan provide many sheltered sites with protection against the open ocean and harsh winter weather conditions.

The Bay of Fundy offers some excellent advantages for salmon farming, however it is anticipated that there are not likely to be more than 60-70 traditional sites available for use in New Brunswick. It is estimated that these sites could produce up from 12,000-15,000 tonnes annually. In addition to the traditional inshore sites, some industry participants are examining the potential of offshore cages for rearing salmon. Offshore cages may offer growers a means of expanding production beyond the limits imposed by the available inshore sites.

Marine Grow-Out Operations

A study published in 1988[1] estimated that, in 1987, there were a total of 525 cages in the Bay of Fundy, 447 of which contained salmon for market. An additional 13 held broodstock salmon , 11 held trout, and 54 were empty. From these 447 production cages roughly 341,000 salmon were harvested with a value of $18 million.

The industry in 1987 consisted of a high proportion of small operations. Only 10% had more than 50 cages in the water (the largest had 70), and nearly half were operating with fewer than 8 cages, each containing an average of 2,900 fish.

By 1989 the number of farms operating in New Brunswick had reached 49, with an estimated production of 4,500 tonnes. The distribution of farm sites by size had changed from 1987 as existing farms increased their capacity and new farms were established:

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[1] Fiander-Good Associates,"Economic Assessment of Salmonid Cage Culture in New Brunswick" 1988

Table 4

Distribution of Farms by Size in Eastern Canada
1989

Number of Fish Per Site	Number of Sites
100,000 or more	7
75 - 100,000	11
50 - 75,000	10
25 - 50,000	10
Less than 25,000	10
Not reported	1
Total	49

Source: N.B. Department of Fisheries and Aquaculture

In 1990 52 licensed farm sites were in operation in New Brunswick, with production projected at more than 8,100 tonnes.

Hatcheries

Smolt production has increased dramatically in New Brunswick during the past few years. In the spring of 1989, hatcheries in the province put approximately 2.2 million Atlantic salmon smolt into sea cages, an increase of 80% over 1988. These smolts are expected to generate over 8,000 tonnes in the 1990/91 market season.

In 1990 there were 10 commercial salmon hatcheries in New Brunswick growing smolts for the aquaculture industry. These hatcheries produced an estimated 2.6 million smolts in 1990 and are expected to produce the same amount for the 1991 season.

Estimates for maximum potential production from New Brunswick sites have been as high as 15,000 tonnes annually. At this level of production, smolt demand would be approximately 4.5 million smolts, assuming a 10% mortality rate, and an average market size of 8 lb/fish. At its maximum development, the New Brunswick industry may require a 25-30% increase in smolt supply.

Major Company Profiles

An estimated 30-40% of 1989 Atlantic salmon production in New Brunswick came from three companies - Connors Bros. Ltd., Nordic Enterprises Ltd. and Sea Farm Canada. These major participants are briefly profiled below.

Connors Bros. Ltd., part of the Weston Group, is a large seafood company based in Atlantic Canada. Connors Bros. has a long history in the Charlotte county region of New Brunswick as a processor and distributor of herring, as well as a range of other seafood products. The company is also an integrated producer of farmed Atlantic salmon in the Blacks Harbour area of southern New Brunswick. Connors operates a 300-tonne grow-out site and an 800,000-smolt hatchery. The company recently took over Ocean Products Inc., the largest salmon farm operator in Maine, U.S, with estimated production levels of more than 1,000 tonnes. Connors Bros. also provides feed as well as processing, marketing and financing services to a number of smaller farms. The company markets products under their own brand name through sales offices in major centres in Canada and the US, including Boston and Los Angeles.

Connors Bros. is also the major feed supplier to the New Brunswick aquaculture industry. They have developed a successful moist feed diet for salmon which is based on herring meal and herring by-products. As the largest herring processor on the Atlantic coast, Connors Bros. has ready access to the inexpensive herring by-products needed to produce moist feed formulations. Its central location in the heart of the Bay of Fundy salmon farming area provides Connors with easy access to its market. The company supplies an estimated 50% of the New Brunswick feed market, and a substantial proportion of the salmon feed market in Maine.

While Connors Bros. Ltd. is likely to increase its share of sales of market fish, competition in the feed market is growing. Recent construction of a fish feed manufacturing facility in Truro, Nova Scotia by the **Shur-Gain division of Canada Packers**, the opening of a salmon feed plant in St. Andrews by **Moore-Clark (Canada) Ltd.** and expansion of the **Corey Feeds Ltd.** plant in Fredericton all offer significant competition for Connors' feed business.

Sea Farm Canada is 50% owned by Sea Farm A/S of Norway, and 50% by Canada Packers Inc., Canada's largest integrated meat processing company. The company operates on both coasts of Canada. Sea Farm A/S is the largest smolt producer in the world and owns 11 hatcheries in Norway. Sea Farm Canada operates three hatcheries and four grow-out sites in New Brunswick and has operations in British Columbia. The company is also associated with Sea Farm Trading, a distributor of fish farm equipment. Production is branded ("Sterling") and marketed through a company division headquartered in Toronto. The East Coast production was about 800 tonnes in 1989 and is projected to be 1,500 tonnes in 1990. Total sales of about $10 million in 1989 were about 40% in Canada and 60% in the US.

Nordic Enterprises Ltd. is an Atlantic salmon farming company with Swiss, Norwegian, Canadian and American ownership. The firm has been in operation for roughly 3 years. Previously headquartered in Connecticut, company operations are now managed from St. Stephen, New Brunswick. The company operates three grow-out sites in New Brunswick and three in Maine. It is not integrated with smolt production but does conduct its own processing and marketing. Nordic markets its products under its own brand name but does not have a large sales force. The company produced approximately 600-800 tonnes in 1989, with total sales estimated to be about $7 million.

In addition to the major producers/processors above, the **Atlantic Silver Cooperative Ltd.** is a major marketer of farmed salmon for a number of New Brunswick growers. Formed in 1985 with six members, Atlantic Silver grew rapidly, reaching an all-time high membership of 25 growers. The co-operative presently has 10 member farmers. Atlantic Silver sales in 1990/91 are projected to be $22 - 24 million.

Atlantic Silver takes orders, arranges transportation and handles payment, records, etc. for its members. Until recently, individual farmers were responsible for arranging processing and delivery of their product to the point of departure for shipment to customers. With the construction of a new 5,000 square foot facility in St. George, the cooperative will now carry out processing and packaging of all products shipped under the Atlantic Silver brand name, providing greater control over quality and the capability for development of value-added salmon products. The cooperative has also announced its intentions to establish Silver Feeds, a division which will produce a silage-based moist diet for sale to member growers.

Government Regulation and Support

Since the introduction of salmon farming to New Brunswick, the provincial government has played an active role in the development of the industry through sound planning and the regulation of growth. This strategy has insured that the industry did not expand beyond the capabilities of the individual farmers and the government to manager them effectively. As a result, the industry passed through its early stages with a sound base for future growth.

The New Brunswick Department of Fisheries and Aquaculture, through the policies and regulations of the 1988 Aquaculture Act, is responsible for monitoring and controlling the overall development of aquaculture in the province. The Department is based in Fredericton, with regional offices in Caraquet, St. Stephen and Shediac. Under the Act, the Department created a new aquaculture division with 16 employees, including biologists, laboratory technicians, a veterinarian, leasing and licensing officers as well as fish hatchery specialists. A fish health advisory board was set up with the cooperation of industry to facilitate consultation prior to the Minister of Fisheries and Aquaculture exercising ministerial authority as defined under the Act. A new advisory committee on aquaculture site selection criteria for South-Eastern New Brunswick was established in 1989.

Aquaculture licences and leases are issued by the department following a review of the submitted application and site-development plan, and public advertisement of the applicant's intention to establish a grow-out facility. Applications are reviewed by an intergovernmental committee consisting of representatives from DFO, Transport Canada (under the Navigable Waters Protection Act), New Brunswick Department of Fisheries and Aquaculture and the New Brunswick Department of Natural Resources (under the Crown Lands and Forests Act). Recommendations of the committee are presented to the Minister of Fisheries and Aquaculture for final approval.

An aquaculture occupation permit is issued on a yearly basis for up to three years. This is considered a trial period in which to evaluate the site and managerial skills of the farmer. Afterwards, a lease is granted for a maximum of ten years. Terms and conditions of leases and licences are site-specific in order to protect the environmental capability of sites and reduce the risk of disease outbreaks. The Department has also established standards for hatcheries and grow-out sites. Site specific limitations have been identified to avoid fish health problems and potential impacts on other users of the marine resource. Standards have also been set to control water use and effluent disposal by commercial hatcheries, thus permitting hatchery development to proceed in an orderly fashion.

In New Brunswick, legislation other than the Aquaculture Act which applies to salmon farming in New Brunswick includes: New Brunswick Fish Inspection Act, New Brunswick Fish Processing Act, New Brunswick Crown Lands and Forests Act, New Brunswick Fish and Wildlife Act, New Brunswick Clean Water Act, Canada Fish Inspection Act, and the Fisheries Act, Canada.

Industry Associations

The primary producer group in the province is the New Brunswick Salmon Growers Association in St. George. The Association was established in 1987 to promote salmon aquaculture, provide industry representation to government and to create a forum for the exchange of professional information on good farming practices.

Support Sector

In 1986, the federal government established the Atlantic Salmonid Demonstration and Development Farm near St George. It provides practical information to assist growers to improve farm efficiency and carries out experiments on such things as equipment, nutrition and stocking densities. Original funding was provided through the Economic Regional Development Agreement (ERDA). That funding terminated in 1989, at which time the operation of the Farm was turned over to the N.B. Salmon Growers Association. The $300,000 in operating funds needed to maintain the Demonstration Farm are expected to come from a number of government agencies such as DFO, Atlantic Canada Opportunities Agency (ACOA), Industry Science and Technology and the provincial Department of Fisheries and Aquaculture.

The N.B. Department of Fisheries and Aquaculture provides a number of training workshops on a variety of topics of interest to salmon farm operators. Formal training for aquaculture workers is provided in New Brunswick by the New Brunswick Community College in St. Andrews. Their one year Aquaculture Technicians Training Program has been running since 1977. It is funded by the N.B. Department of Advanced Education and Employment and Immigration Canada.

The Aquaculture Division of the N.B. Department of Fisheries and Aquaculture provide various services such as fish health monitoring and training workshops. It is also helping to develop new species and procedures for use by the industry. and provides technical support and extension services for practitioners. Other technical support is available within the province from the Research and Productivity Council (RPC), based in Fredericton. RPC, a provincial research organization, provides disease monitoring, fish health monitoring, engineering services and value-added food product development expertise to the aquaculture industry on a fee-for-service basis. Other sources of technical assistance include the Atlantic Veterinary College in Charlottetown, P.E.I. and the DFO laboratories in Halifax.

A wide range of other products and services are available from local suppliers in Southern New Brunswick. There are now three major feed manufacturers based in New Brunswick - Connors Brothers Ltd., Corey Feeds Ltd. and Moore-Clark. In addition, the Shur-Gain Division of Canada Packers, in Truro, Nova Scotia, has recently introduced a line of feed products for the salmon farming industry. Local businesses also supply steel cages, mooring systems, nets, boats and motors and any required professional advice to farm operators.

Nova Scotia

Marine Grow-Out Operations

Salmon aquaculture in Nova Scotia is much more limited than in New Brunswick but the province is now producing considerable amounts of Atlantic salmon, particularly in Cape Breton and along the Southeast shore. Most of the commercial salmon farms in Nova Scotia also grow marine, or steelhead, trout, which do not require overwintering and can therefore be used to generate cash flow each year.

In 1987 there were ten commercial farms reporting a total harvest of 37 tonnes. In 1989 a reported 145 tonnes were produced by farms in Nova Scotia. The most recent statistics indicate that there are currently 18 licensed salmon farms in Nova Scotia, 5 of which are commercial scale operations and 13 are pilot, or experimental scale, sites. Appendix 4 summarizes Nova Scotia industry production from 1986 to 1990.

Industry growth in Nova Scotia has been much slower than in New Brunswick. A number of factors have contributed to this modest growth. The industry is physically dispersed throughout the province, with no single area of concentrated effort in salmon farming. This has made it difficult to establish a service infrastructure such as feed manufacturing, processing and marketing capabilities, equipment manufacture and supply, and other services.

Multi-use conflicts with shoreline property owners and local residents near proposed sites, and with traditional fishermen in some areas, have also limited the growth of the industry to some degree. Concerns about the effect of aquaculture operations on the value of properties which overlook aquaculture sites, access to waterways for recreational use, and concern for the effects of fish farming on traditional lobster grounds and on the environment in general have been identified as the major reasons for opposition to the development of new farm sites. Finally, severe winter conditions have limited the growth of salmon farming in some areas of Nova Scotia.

Lack of concentration in the industry, conflicts with other users and a harsh winter climate have all made it difficult for the industry to generate government support in the past. The Aquaculture Association of Nova Scotia and the provincial government have been working together to establish strategies which will guide future industry growth and development.

Hatcheries

In 1990 eight private smolt producers in Nova Scotia provided approximately 600,000 smolts to the marine grow-out industry in the Province. Only 350,000 smolts were actually placed in cages this year, the remainder being surplus to industry needs. Smolt production capacity has increased over the past few years, primarily in response to the projected requirements of Clearwater Fine Foods. Clearwater's growth projections were not realized, and the company has recently withdrawn from the industry, leaving significant excess capacity in the Nova Scotia hatchery industry.

The oversupply of smolt in Nova Scotia has reportedly caused serious financial problems for several hatchery operators. Since current fish health regulations prohibit the transfer of Nova Scotia smolts outside the Province, potential demand in New Brunswick is not available to suppliers in Nova Scotia.

Major Company Profiles

There are five commercial producers of farmed salmon in Nova Scotia: **Nova Aqua Ltd.** and **Loch Bras d'Or Salmon Farms Ltd.** in Cape Breton.; **Scotia Salmon Farms Ltd.**, near Shelburne in the Southern portion of the Province, and **Ocean Farmers Ltd.** and **Aquatech Ltd.**, both on the south shore of the province near Halifax.

Nova Aqua Ltd. operates a hatchery and two grow-out sites, one of which is a land-based facility with an estimated total production capacity of roughly 2,000 tonnes for both salmon and steelhead trout. Nova Aqua markets its salmon through a joint venture arrangement with National Sea Products Ltd. of Halifax.

Scotia Salmon Farms Ltd. was recently formed following the sale of the salmon farming operations of Clearwater Fine Foods, a large integrated seafood processor, to owners of a private hatchery (Mic Mac Smolts). The new entity will be an integrated salmon producer.

Government Regulation and Support

The Nova Scotia Department of Fisheries is responsible for co-ordinating the development of commercial salmon farming in that province. The Department ensures the proposed lease does not conflict with other operators, marine traffic, residents, fishing, or unfavourable exposure.

The Department of Fisheries has been accepting applications for operational aquaculture licences and leases since August, 1986 . Various parties to the application review process include nine provincial and federal government bodies. These include: Nova Scotia Department of Fisheries (administration, licensing, leasing), Department of Environment (fresh water permits and effluent control), Department of Agriculture and Marketing (activity conflict review), Department of Municipal Affairs (land use), Department of Mines and Energy (lease conflict) and the Department of Lands and Forests (conflict with forestry activity). Federal government participation includes: DFO (wild fishery and fish health), Transport Canada (navigation), Environmental Protection Service of Environment Canada (water quality and pollution).

In cases where significant public concern is demonstrated a public hearing may be held near the proposed site, after which the Minister of Fisheries may issue the licence. Leases and licences may be issued without a public hearing. The lease permits the use of an area of water owned by the Crown at a fixed rent per hectare per year.

Financial support for capital development to salmon farmers has been available from the provincial Department of Fisheries since the mid 1970s through the Fisheries Loan Board and capital improvement grants. Further financial support for capital works and research and development was obtained through the Fisheries sub-sector under the federal/provincial Economic Regional Development Agreement (E.R.D.A.) over the past four years.

Other laws and regulations which apply to aquaculture in Nova Scotia include: Fish Health Protection Regulations pursuant to the Fisheries Act (Canada) and the Nova Scotia Fish Inspection Regulations of the Fisheries Act for salmon processors.

Industry Associations

The Aquaculture Association of Nova Scotia is an active lobby and support group with membership of more than 300, including growers, processors, equipment suppliers and others with an interest in the provincial aquaculture industry. The Association holds a three day conference each year, publishes a newsletter, represents the industry in discussions with government and promotes Nova Scotia aquaculture products, under the "Scotian Pride" marketing program.

Support Sector

In 1990, the Community College, Shelburne Campus held the province's first 20 week training course. The Training and Field Services Division of the Nova Scotia Department of Fisheries has tentatively scheduled two 20 week courses for 1991. Activities sponsored to date by the Department have been limited to one or two day information sessions and seminars for aquaculture operators.

Several universities also have courses in aquaculture. These include Dalhousie University, Technical University of Nova Scotia, University College of Cape Breton, Bras d'Or Institute, and St. Francis Xavier University.

Nova Scotia salmon farmers draw on the DFO laboratories in Halifax for fish health and diagnostic services. The Atlantic Veterinary College in Charlottetown also provides assistance in fish health monitoring and control. Other specialized technical services are available from Dalhousie University and the Technical University of Nova Scotia, the N.S. Department of Fisheries, Department of Fisheries and Oceans and the National Research Council. As in New Brunswick, there are a number of local suppliers of cages, moorings and other equipment.

Prince Edward Island

At present there is very limited activity in salmon aquaculture in Prince Edward Island. Only one farm is reported to be experimenting with salmon grow-out, with a few thousand fish in the water. A hatchery operation in P.E.I. is also experimenting with salmon smolt.

One of Canada's first land-based saltwater tank farms was established in Georgetown, P.E.I. Due to inadequate financing the farm went into receivership in December, 1988. The plant was purchased by US interests in March, 1989, however it was put into receivership again in February, 1990. At the time this report was prepared, no acceptable bids for the facility had been received.

Government Regulation and Support

The responsibility for co-ordination of the salmon farming industry in Prince Edward Island is shared between the federal, provincial and municipal levels of government. The Federal Department of Fisheries and Oceans administers licences and leases for aquaculture operations. There is no provincial legislation specifically concerned with aquaculture, although a Memorandum of Understanding does exist between the province and the federal government. Applications for salmon farming licences are processed by a finfish specialist located in the P.E.I. Department of Fisheries in Charlottetown.

Four government bodies are involved in reviewing applications for salmon farming. These include the P.E.I. Department of Fisheries and Aquaculture; P.E.I. Department of Community and Cultural Affairs, Fish and Wildlife Division (concerned with wild stock enhancement, recreational activities and resource conflict); Transport Canada (through the Navigable Waters Protection Act); and DFO, Habitat Division and Science Branch, (regarding water use).

Support Sector

Technical and academic courses in aquaculture are provided by Holland College and the Atlantic Veterinary College.

The Department of Fisheries and Oceans Fish Health Service Unit in Halifax, the Atlantic Veterinary College in Charlottetown and the University of Guelph in Ontario provide fish health services to PEI fish farmers.

Newfoundland

The farming of salmon in Newfoundland is still in the very early stages of development. Smolts were first introduced to sea cages in 1987, but poor broodstock and a subsequent outbreak of disease the following year wiped out all hatchery and grow-out operations in the Province. The industry is now recovering and attempting to re-establish itself. Newfoundland's only salmon hatchery, located in Bay d'Espoir, produced a limited number of smolts in 1990. A consortium of three aquaculture companies purchased the Bay d'Espoir smolts and placed them in sea cages in the spring of 1990 for harvest in 1991.

Quebec

In Quebec, salmon production for the period May 1988 to April 1989 was 56 tonnes. Production for 89/90 was only 25 tonnes due to a bacterial disease outbreak. There is only one producer who employs approximately 18 people. This producer expanded its operations in 1989 and expects to employ 45 to 50 people and produce approximately 600 tonnes by 1992 or 1993.

Salmon fishing in Quebec is limited because of severe winter water temperatures and ice. A land-based commercial Atlantic salmon farm in the Baie des Chaleurs region of the Gaspe peninsula is expecting to produce in the neighbourhood of 500 tonnes within the next few years, although production was lower than expected in 1989/90 due to bacterial disease. A second operation in the Saugenay River estuary has experimented with salmon in hatchery and seasonal cage operations. The firm will attempt to overwinter salmon this year in brackish waters of the river.

Concentration

In New Brunswick, an estimated 30%-40% of farmed Atlantic salmon production is provided by three firms - Connors Bros., Sea Farm Canada and Nordic Enterprises. Both Connors Bros. and Sea Farm are also active in establishing marketing relationships with smaller growers. The larger, integrated firms assist smaller growers. The larger, integrated firms assist smaller growers in financing the purchase of feed and smolts, in return for access to the grower's output, at an agreed-upon price, for marketing, in effect establishing networks of contract growers. Financial assistance may also be tied to long-term supply contracts for feed and/or smolts.

Hatchery capacity in New Brunswick is also dominated by Connors and Sea Farm, although there are a number of smaller, private hatcheries operating in the Province. The feed industry in New Brunswick is dominated by Connors Bros., which produces a moist feed preparation from waste herring. Connors' feed sales account for roughly one-half of total feed consumption in New Brunswick. Deer

Island Processing also produces and markets a moist feed preparation to local farmers. A number of producers of dry feeds are active in the province, including Corey Feeds Ltd. and Moore-Clarke, both with production facilities in New Brunswick. EWOS and Ziegler have local distributors, and Shur-Gain produces feed in Nova Scotia for the salmon farming industry. Atlantic Silver has also announced plans to produce a silage-based feed for its members. Thus, while Connors dominates the feed market in general terms, there is a great deal of competition for the remainder of the market.

Integration

Connors Bros, and Sea Farm Canada are the only fully integrated aquaculture firms in Eastern Canada. These companies operate hatcheries, supply feed, raise, process and market salmon. Connors Bros. manufacture their own feed, while Sea Farm participates in the feed industry through parent company Canada Packers. Canada Packers also owns the Shur-Gain Division in Truro, Nova Scotia, a producer of a wide range of feed products.

In Nova Scotia, Nova Aqua Ltd., in Cape Breton operates both hatchery and grow-out facilities, as does Scotia Salmon farms. There are no salmon farming operations with associated feed production capabilities in Nova Scotia.

Foreign Investment

The level of foreign participation in the Eastern Canadian salmon farming industry is modest. Sea Farm Canada, with head offices in Toronto and operations on both Atlantic and Pacific coasts, is 50% owned by Sea Farm A/S of Norway and 50% by Canada Packers.

Nordic Enterprises, based in St. Stephen, New Brunswick, has Swiss, Norwegian and American owners, in addition to Canadian partners. In Nova Scotia, Nova Aqua Ltd., in Cape Breton was established by joint venture between a local firm and Norsk Aqua A/S of Norway. There is no other major foreign investment in Nova Scotia salmon farms.

Products and Markets

The Product

The Pacific salmon farming industry has focused on coho and chinook salmon, both of which are difficult to cultivate. The East Coast industry farms the more cooperative, hardy and dependable Atlantic salmon. Smolts are placed in sea water in the spring, fed one winter and harvested in the fall/winter of the following year. A cage-reared Atlantic salmon takes 18 months to reach a marketable size of 6 to 9 lbs.

The large majority of salmon production in Atlantic Canada is shipped as fresh product, usually whole or gutted. In this form the product has a limited shelf life, making transportation to markets a key issue in the marketplace. The Maritime provinces and Quebec are close to the large markets in the Eastern and Central United States, a valuable asset to local fish farmers. Regular air service from Halifax and Saint John to major centres in Central Canada and to the Eastern Seaboard of the United States, together with a well-developed trucking network, mean that salmon can usually be at their destination within 24 hours of processing.

In the early years of the industry, the salmon marketing season was limited largely to November and December, during which time 90% of production was sold. This proportion has dropped to 60%, with sales prior to Christmas starting in early autumn, and extending well into March of the following year. The marketing season is therefore extended to a six month period, and the industry is moving towards a year-round supply of market fish.

While the salmon farming industry in Eastern Canada is growing, with significant economic benefit to the region, it comprises a small proportion of total world production. As world production continues to increase and the markets for fresh salmon become more competitive, a large number of farmers, processors, marketers and government officials recognize the need for a more diverse range of products. It is becoming increasingly apparent that value-added products geared to an increasingly demanding consumer will open up specialized markets essential to the long-term viability of Eastern Canada's fish farming industry. Fresh salmon are smoked, vacuum packed and shipped throughout North America. Patés are being produced for the delicatessen market and other value-added products such as ready-to-serve salmon dishes are being explored.

Prices

Until recently, the demand for cultured salmon exceeded the supply. New Brunswick was in an excellent position to benefit from the increasing demand world-wide for aquaculture products as a stable, quality source of seafood. But recent rising world production of farmed Atlantic salmon has resulted in an increasingly competitive market. The industry has responded by developing a marketing strategy based on increased volume, premium quality and competitive prices.

The Atlantic salmon market seemed to be an entity unto itself for much of 1989. Prices were consistently strong well into the fall. From August to early December, the price of Eastern Canadian Atlantics dropped by 15% for 6-9 lb. fish, and 19% for larger fish. Some Atlantic producers had the opportunity to market fish in September, but chose to wait until later in the season to take advantage of additional growth of their fish, and subsequently were faced with lower prices. Compounding the situation was the influx of Atlantic salmon onto the US market from Norway, Scotland, Chile and British Columbia. For the first time, both British Columbia and Chile supplied significant quantities of Atlantics to the US market.

By mid-December, Atlantic wholesale prices had hit rock bottom in the view of most marketers. By March 1990, world prices had stabilized. However, there is little prospect of any further strengthening as Atlantics have continued to be plentiful well into 1990 and have been joined by farmed cohos from Chile and chinooks from New Zealand.

The Market

Approximately two thirds of aquaculture products go to the food-service industry such as restaurants and hotels with the remainder going to the retail sector. Markets for farmed Atlantic salmon include Boston, Chicago, New York, Montreal, Toronto, Ottawa and to a lesser extent San Francisco and Los Angeles. Most salmon farmers in Eastern Canada sell the majority of their fish outside the Maritimes. A few will supply local markets such as Saint John or Halifax.

Markets for New Brunswick farmed salmon were evenly distributed between Central Canada and the US in 1988 but a greater proportion of the increases in salmon production in 1989 were sold in the US. Salmon prices obtained in Central Canada were generally higher than those obtained in the US where Norwegian salmon has a stronger market presence.

Marketing Activities

The larger New Brunswick producers all maintain their own sales forces. Both Sea Farm and Connors Bros. have representatives in both Canada and the US. Nordic Enterprises Ltd. and Atlantic Silver coordinate sales efforts from their New Brunswick headquarters. All four organizations market products for smaller producers who cannot afford to undertake their own marketing activities. Other smaller marketing groups are also operating.

Until recently, the marketing of farmed Atlantic salmon was not an issue in the industry since demand outstripped supply. As the industry has expanded, supply increased and prices declined, salmon marketers are beginning to realize the importance of establishing a joint effort to combat the pricing problem. A committee representing most of the New Brunswick marketing groups and the New Brunswick Salmon Growers Association was formed to initiate the development of combined promotion activities and to establish a New Brunswick presence in the market-place. Because of its small market share, the New Brunswick industry cannot expect to be the price setter. Marketing efforts will therefore be more directed at promoting a premium image for the New Brunswick product.

The New Brunswick Salmon Growers Association has been promoting farmed salmon by hosting tours and luncheons. In early 1989 it hosted a fish farm tour for 25 newspaper editors and writers from across the country. The Association has also sponsored a salmon luncheon for the Canadian Federation of Commercial Chefs in Halifax in May, 1989. About 80 chefs sampled farm-raised product at the luncheon. The Association also recently initiated a promotional campaign ("Salmon Savvy") targeted at the food service industry and designed to increase the awareness of New Brunswick salmon.

Competition

Scottish and Norwegian farmed salmon and wild salmon caught in the salt water, and Atlantic Canada's only remaining commercial salmon fishery, are New Brunswick farmer's major competitors. Competition for the large Eastern US market comes from Norway, Scotland, Chile and British Columbia. The United States is also producing farmed salmon but only to the extent of 2,000 tonnes per annum and primarily on the west coast. Their wild caught salmon from Alaska are the primary competition in these markets.

Although production of farmed salmon in the United States is low at present, American producers represent significant potential competition for Canadian farmed salmon in the large US market. An indication of this potential is the recent (summer 1990) acquisition of Ocean Products Inc. (OPI), the largest aquaculture company in Maine, by Connors Bros. of Black's Harbour, New Brunswick.

The Norwegians are very aggressive marketers, and have established a sales office in the US in order to fully penetrate that market. Promotional efforts by the national salmon marketing agency in Norway have been instrumental in establishing the Norwegian product as the benchmark for farmed salmon.

In the current oversupplied market, price would appear to be the predominant interest of buyers, as opposed to quality and consistent supply. Although some of the New Brunswick marketing groups receive a premium for their product, or at least maintain a position at the high end of the price range, they still lack a strong market profile in the important US market.

In addition to competition for the US market from producers in other countries, there is a significant level of competition, and fragmentation of marketing effort, among New Brunswick producers for Eastern North American markets. At present there are at least eight groups selling New Brunswick Atlantic salmon. These include Atlantic Silver Ltd., a Campobello consortium, Connors Bros. Ltd., Deer Island Salmon Ltd., Harbour D'Loutre Salmon Ltd., Jail Island Salmon Ltd., Nordic Enterprises and Sea Farm Canada Ltd.

Economic Performance

The salmon farming industry on the Atlantic coast is generally considered to be more economically stable than on the Pacific coast. The industry is relatively small, and has grown slowly, and in a controlled fashion. In New Brunswick, the Department of Fisheries and Aquaculture has estimated that roughly 400 direct jobs have been created in salmon farming, with an additional 1,000 spin-off jobs in the manufacture and supply of goods and services required by the industry.

In 1990, total New Brunswick salmon farming industry spending (excluding capital) is estimated to be roughly $44.6 million. Three major cost components - feed, smolts and labour - accounted for 75% of these costs, while the remaining 25% is comprised of indirect and overhead operating costs such as insurance, marketing, processing and other costs. Estimated industry spending in New Brunswick is summarized below. These estimates have been developed using information from a number of sources, including New Brunswick Department of Fisheries and Aquaculture, the 1988 Fiander-Good study and on recent discussions with industry participants.

Table 5

New Brunswick Salmon Farming Industry Spending
1990

	$ Million	%
Feed costs	$16.8	38
Smolts	10.4	23
Labour costs	6.4	14
Other costs	11.0	25
Total	$44.6	100 %

Source: Based on information from New Brunswick Department of Fisheries and Aquaculture and Fiander-Good Associates, Economic Assessment of Salmonid Cage Culture in New Brunswick (1988)

The industry in Nova Scotia is less well characterized, with no similar estimates for total annual spending available.

In order to obtain more detailed financial information, a survey of salmon farmers in Eastern Canada was conducted. Survey response was poor, reflecting difficulties experienced by other organizations attempting to gather financial information about the industry from industry participants. Only 11 (14%) of the 81 salmon farmers surveyed provided useful financial information. The respondents are typical of newer, smaller farms, especially in New Brunswick. One half of the respondents have been in operation for less than 2 years, while the remainder have operated no more than 5 years. Information from larger salmon farms was not provided.

Although response was poor, and the information not truly representative of the Eastern Canadian industry as a whole, selected results from the survey are used in this section to describe some of the financial characteristics of the industry.

Operating Costs

As noted above, three major costs, feed, smolts and labour, account for 75% of total industry spending in New Brunswick. The survey results, based on 1989 data, confirmed this approximate breakdown of operating costs. Survey respondents in New Brunswick reported the following average operating costs in 1989:

Table 6

Costs of Production in Eastern Canada
1989

	$	%
Feed	$196,300	32
Labour	145,800	23
Smolts	124,500	20
Other costs	154,700	25
Total	$621,300	100 %

Source: Price Waterhouse Survey

Each of the major operating cost element estimates are reviewed below.

Feed Costs

An estimated $16.8 million was spent on feed in New Brunswick in 1989. This estimate is based on average feed consumption rates and the estimated number of fish in the water, and assumes that all feed sales are moist preparations (a majority of salmon farmers in New Brunswick use moist feeds).

On average, New Brunswick farmers responding to the survey reported 1989 feed spending of $196,000. Respondents elsewhere in Eastern Canada reported spending $65,000, reflecting smaller farm sizes in these areas.

Labour costs

On the basis of previous industry studies, labour requirements have been estimated to be 1 full time worker for every four cages, and one part-time worker for every eight cages. In 1990 there are 1,027 cages in the Bay of Fundy, with an estimated 375-400 workers, bringing total labour costs of $6.4 million.

Survey respondents indicated an average of 4 full time and 2 part time employees per farm in New Brunswick, with average labour costs at $196,000 in 1989, or 23% of total operating costs. In other provinces, employment was 1-2 full time and 2-4 part time, with average labour costs of $86,000. In these farms, labour appears to be the most significant cost component, while the New Brunswick farms, feed costs are the largest component.

Smolts

In 1990 most farmers paid $4.00 per smolt in New Brunswick. With approximately 2.6 million smolts purchased this year, the total value of smolts in 1990 reached $10.4 million.

Smolt costs comprised 20% of total estimated operating costs both in New Brunswick and in other provinces in 1989. An average $124,500 was spent by New Brunswick respondents to the survey in 1989, while farmers in other provinces spent an average of only $50,000 on smolts.

Other Costs

Other costs include veterinarian charges, insurance, processing/marketing charges and overhead costs. No detailed breakdown of these costs is available, although they comprise an estimated 25% of total operating costs of New Brunswick farms. For the farms responding to the survey "other" costs averaged $254,700. One of the major "other" costs is insurance.

Fish insurance costs are typically calculated on the basis of the maximum value at risk. This value is normally reached in the fall of the year, prior to harvest, when market fish are reaching their peak size, and the year's smolts have been growing for roughly 6 months. The value at risk, even for small farms, can easily reach the $1 million level. At this level, premiums would be $35,000-40,000 per year. Insurance for capital assets is also commonly purchased, with premiums determined by the approximate depreciated value of the assets.

Summary of Operating Costs

Average production of respondent farms in 1989 was 61,200 kg. Cost of production could therefore be estimated at $4.61/kg. However, since the responding farms include a large proportion of new operations in which there was no production in 1989, this cost of production estimate is believed to be overstated. The 1988 Fiander-Good study estimated costs of production at $6.40/kg ($2.91/lb.) before interest and taxes, for a hypothetical average farm in New Brunswick.

Capital Costs

The start-up capital costs for a modest (24 cages) salmon farm in New Brunswick is estimated to be between $300,000 and $500,000. This range has been estimated on the basis of information from a number of sources within the industry.

The bulk of the capital costs go to the purchase and installation of cages, nets, mooring systems and other equipment. These costs may range from $175,000 to $230,000, depending on the size and construction (wood, plastic, steel) of the cages purchased. Many new farmers enter the industry for considerably less than the amount indicated above by building their own cages based on a proven, locally-designed wooden cage. Other major assets include boats, motors and trucks, as well as land and buildings.

Table 7

Capital Investment Costs
in Eastern Canada
($000's)

Cages/moorings/equipment	$175 - $230
Vehicles/boats/motors	$ 30 - $100
Land/buildings	$ 75 - $150
Other	$20
Total	$300 - $500

Source: Fiander, Good & Associates, Economic Assessment of Salmonoid Cage Culture in New Brunswick (1988)

Robert H. Cook, "Salmon Aquaculture in the Bay of Fundy: A Quiet Success" Aquaculture Association of Canada, Edition 88-2 (June 1988)

Discussions with industry participants

Survey respondents' capital assets were lower than the estimates provided in Table 7. The average, undepreciated value of the assets of those farms in New Brunswick responding to the survey were cages/moorings/equipment $158,400; vehicles/boats/motors $42,800; and land/buildings/other $44,800 which gives a total of some $246,000.

The total capital base of the industry is difficult to estimate. On the basis of the figures above, investment in grow-out sites may be expected to reach a maximum of $13 to $22 million. This excludes investment made in processing facilities, hatcheries and feed manufacturing facilities, directly related to the growing of salmon. Other capital investments would include those made by companies manufacturing goods or providing services to the industry.

The capital base of the industry has been developed modestly and without a high level of debt financing. Early participants in the industry made much of their own equipment, particularly cages, and did not invest heavily in products imported from other countries. Investments in hatcheries and feed production facilities were left to the larger firms with the financial capacity to carry the investments. More recent entrants have benefitted from the experience of the early farmers, many starting with wooden cages and gradually moving to more expensive steel or plastic cages as they gained experience, and cash flow.

In the future it is anticipated that an increasing proportion of industry investment will be directed towards equipment for improving the operating efficiency of salmon farms. Increasing world production, low salmon prices and reduced margins are expected to lead to interest in automatic feeding systems and other automated equipment intended to reduce labour costs and enhance the efficiency of grow-out operations.

Financing

Operating Capital

Cash flows, and the resulting working capital requirements of a salmon farm vary widely through the year. For a start-up farm, no revenues may be expected for 18 months, when the first smolts mature to market size. During these months there are cash outflows for feed, labour and the purchase of the second year smolts, with no corresponding cash in-flows. Following the first year of operations a more regular pattern of cash flow develops. Feed and labour costs are incurred throughout the year, although they are somewhat lower in the winter months due to lower feeding rates. In the spring a major cash outlay for smolts must be made. Revenues are generated from October to March as the salmon are harvested.

The availability of, and access to working capital funds are the most significant financial concerns of the salmon farming industry. Three principal sources of financing are used: chartered banks, government, and trade creditors.

Chartered banks will supply farmers with an operating line of credit, provided that the borrower has equity in the company, proven experience in management, insured fish stocks and some form of security. The opposite applies in British Columbia where fish stock and farm assets cannot be used as loan equity. Operating lines are based on a percentage of receivables and/or a percentage of inventory value. Operating lines of $300,000 to $600,000 for a modest sized farm are not uncommon. New Brunswick farmers responding to the survey reported an average bank operating loan of $296,300 in 1989.

Security for operating lines, allowing salmon farmers to access capital and operating loans, is available to New Brunswick farmers in the form of loan guarantees from the provincial Department of Fisheries and Aquaculture and the federal Atlantic Canada Opportunities Agency. In the case of the Department of Fisheries and Aquaculture, the guarantee term is five years, to a maximum of 75% of the requirements identified in an approved business plan. In the third year the guarantee is reduced by one third, and by one third in each of the remaining two years. The guarantee program was intended to provide new farmers with the assistance needed to being operations and become established over the first two years, and to be in a financially self-sufficient position by the end of the five year period.

A third source of operating capital is trade creditors. Feed and smolts costs comprise 45-50% of total operating costs. The principal suppliers of these products in New Brunswick are Sea Farm Canada Ltd. and Connors Bros. Ltd. As large corporate entities, these firms have the financial strength to provide trade credit to some operators. These firms are then in a position to market the debtor's fish under their brand name, thereby gaining market share. Such arrangements may also lead to long-term supply contracts for feed and smolts.

In the past year, as salmon prices have declined, interest rates have risen, and loan guarantees have begun to decline, the number of smaller farmers seeking assistance from the trade appears to have increased. However, as creditors provide increasing financial assistance, smolt supply, feed and marketing capabilities, the industry may become increasingly controlled by a small number of participants.

Capital Costs

The financing of capital costs for salmon farming is typically comprised of equity, term financing from banks and government loans or grants. The proportions of these financing options vary widely from one farm to the next, and between provinces.

The Atlantic Canada Opportunities Agency will provide new or growing salmon farms with financial assistance for capital costs. New projects up to $200,000 are eligible for non-repayable contributions up to 50% of capital costs. Expansion projects are eligible for up to 30% contribution. On projects over $200,000, the non-repayable contribution is limited to 25%, and is repayable if it exceeds $100,000. ACOA will provide loan interest buy-downs of up to six per cent on loans for capital equipment over $25,000. In order to qualify for ACOA assistance, applicants must have at least 20% equity in the project.

The provincial government in New Brunswick has no source of capital assistance for the aquaculture industry. In Nova Scotia, the Fisheries Loan Board will provide loans for capital equipment for aquaculture operations.

Chartered banks are generally willing to provide capital financing in the form of term loans. The farmer must have equity in the project, and the loan must be secured. Long-term bank loans were reported by New Brunswick survey respondents averaging $237,500.

Industry Outlook

New Brunswick is expected to continue to be the dominant province in salmon aquaculture in Eastern Canada over the coming several years. The 60-70 suitable sites in New Brunswick could produce up to 15,000 tonnes annually, when fully developed.

The New Brunswick salmon farming industry has established a sound base of expertise in raising salmon in the Bay of Fundy. It is expected that, in response to strong competition for traditional whole, fresh salmon in major North American markets, the development of greater expertise in marketing will become a priority in the New Brunswick industry. The increased emphasis on marketing of salmon, as opposed simply to sales, will likely include a more detailed assessment of major markets consumer buying habits, product preferences and expectations, price sensitivities, demographics, market segment sizes and growth, etc. Emerging from this marketing thrust will be new value added products and a more sophisticated, targeted approach to the marketing of farmed salmon.

Farmed salmon production in Nova Scotia in 1990 is projected to be 300 tonnes, according to provincial government figures. The "medium growth" scenario for Nova Scotia, prepared by Price Waterhouse for DFO (Long Term Production Outlook for the Canadian Aquaculture Industry", March 1990) forecasts 600 tonnes of salmon production by 1995, and 2,000 tonnes by 2000. Achievement of these levels will be determined largely by the ability of the industry to locate and develop suitable sites for salmon grow out. In addition, many of the same marketing issues facing New Brunswick salmon growers will also impact on the industry in Nova Scotia.

Strengths and Weaknesses

Strengths

- The major producing area of the Bay of Fundy is close to major market centres in the Northeastern US and in Central Canada. Product delivery times of 24 to 48 hours, following harvest, are possible ensuring top-quality fresh product is supplied to the market. Delivery costs are significantly lower than those of competitors in Norway, Scotland and Chile.

- The Bay of Fundy is one of the most important herring producing areas of the world. Herring have proved to be a very desirable base for salmon feeds, providing the natural ingredients for the moist diets used by the majority of operators in New Brunswick. The traditional fishery will thus benefit from salmon farming, and increased demand for fish to be processed into feed will help eliminate fish wastes and have a positive effect on the environment.

- Most coastal communities in Atlantic Canada are served by good roads and linkages with other modes of transportation which allow export markets to be reached cost effectively and quickly.

- The Atlantic provinces contain a well-established infrastructure of equipment suppliers, processing facilities, fishermen, tradesmen, fisheries biologists, etc. that have the skill and resources to support the industry. Rural communities have the available manpower and need the employment that the industry provides.
- The Bay of Fundy has very high tides which ensure excellent exchange of water in sea cages and reduction in the build-up of residues beneath the cages.
- The Atlantic salmon species is a hardy one, with mortality rates of less than 10% per year. The industry has developed sound husbandry techniques based on the Atlantic salmon.
- Strong provincial government support for, and regulation of the salmon farming industry in New Brunswick ensures a solid base for future growth.

Weaknesses

- The climate of the Atlantic provinces is such that the risk of superchill during the winter months can never be discounted. The harsh winter climate can also create operational problems such as freezing water surfaces, and reduced feeding rates and consequently slower growth.
- In addition to the climatic risks associated with salmon farming in Atlantic Canada, the risk of disease is also present. The industry is developing sound fish health management techniques to minimize this risk.
- The risky nature of salmon farming makes it difficult for some potential entrants to obtain start-up capital, and for some participants to adequately finance on-going operations.
- Multi-use conflicts have been a factor in limiting the expansion of salmon farming in Nova Scotia and, to some extent, in New Brunswick. In some communities, proposed fish farms may be seen as a threat to the traditional fishery or as unsightly additions to views from oceanside residential properties. In New Brunswick salmon farmers and traditional herring weir fishermen often compete for the same sites.
- The New Brunswick industry has not yet developed a strong generic market presence in the major markets. There are between six and eight different marketing groups promoting New Brunswick salmon in Canadian and US markets.
- The potential for major expansion beyond 12,000-15,000 tonnes in New Brunswick is restricted by the limited number of suitable farming sites available.

Salmon Farming in Norway

Historical Development

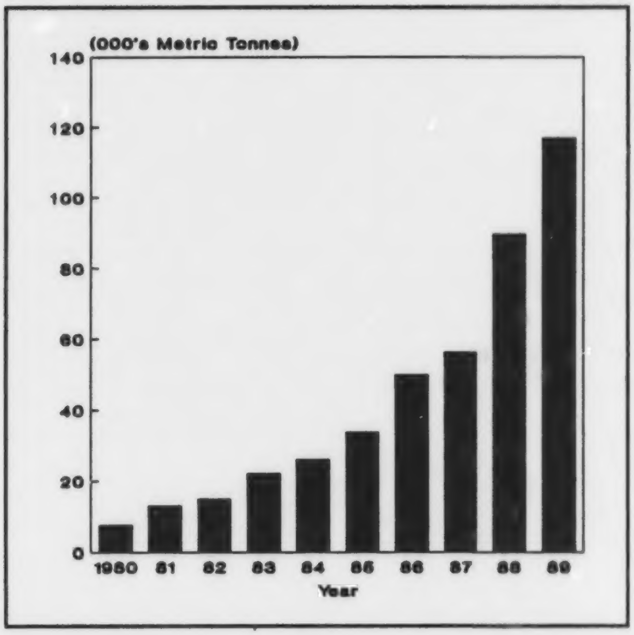
Following trials by private interests, in 1968 the Norwegian government initiated its first attempts at salmon farming as a response to depleted wild stocks of salmon. The results were generally positive, which encouraged the establishment of several small commercial and research ventures along the west coast of Norway. The government was supportive of these efforts, as they were consistent with the government's political goals of increasing employment and economic diversification in the economically depressed fjord region. Thus, many traditional fishermen began fish farming.

In 1971, Norway produced 100 tonnes of farmed Atlantic salmon. The farmed salmon was well received by consumers and there were indications were that salmon farming could be very lucrative. Consequently, salmon aquaculture began to expand very quickly. In order to encourage orderly, systematic growth of the industry the government intervened in the industry in 1973 by passing legislation which limited farm size to 8,000 M^3. In 1980, production reached some 7,500 tonnes and increased to 117,000 tonnes by 1989.

The following chart illustrates the growth in production between 1980 and 1989 (see appendix 5 for more detail).

Salmon Production in Norway
1980 - 1989

Chart 5



In response to the tremendous growth of the industry, the government created the Fish Farmers Sales Organization (FFSO) in 1978. This body assumed legal authority for regulating all marketing of raw salmon. In the same year the Norwegian government made additional legislative changes to encourage expansion of Norway's hatchery industry and these further fuelled industry growth.

Norway is the world leader in salmon production and salmon aquaculture is a major force in the Norwegian economy. In 1989 Norwegian salmon accounted for 72% of worldwide farmed Atlantic salmon production and 58% of total farmed salmon production. The total value of 1988 production was 3.4 Nkr billion $583 million). Norway has an almost unlimited number of locations for aquaculture, as a result of a long coastline with fjords and islands that protect fish farms from winter weather conditions.

Industry Structure

The evolution of the salmon farming industry in Norway has been significantly influenced by government intervention. The government has at various times, either directly or indirectly, controlled smolt production, salmon production, and salmon marketing.

In 1988, according to the FFSO there were 692 hatcheries, 300 smolt producers, 786 salmon farms and 78 purchasers. Purchasers are licensed by the Norwegian government and include marketing companies and exporters.

A government license is required to raise salmon in Norway. These licenses restrict the size of fish farms to a maximum 12,000 M^3 (raised from 8,000 M^3 in 1988). The output from a farm varies considerably, up to a maximum of approximately 300 tonnes. In 1989, there were 790 farms in Norway with a capacity of 175,000 to 200,000 tonnes.

Government intervention has influenced the industry's evolution such that three types of farms have emerged:

- Small scale farms which produce approximately 60 tonnes annually from pens with an area of approximately 6000 M^3. Most Norwegian salmon farms fall into this category.
- Marginally larger operators which have output up to 300 tonnes.
- Industry leaders such as Mowi. This classification comprises those firms that initiated operations prior to the passage of laws in 1973 which restricted size.

Government limitations on size and ownership have deliberately attempted to sustain small owner operated business and employment in rural areas of Norway. These objectives appear to have been achieved, since, relative to other producing nations, Norway has a greater concentration of small, owner-managed operations. There are a few exceptions, however, such as Mowi, a subsidiary of the multinational firm Norsk-Hydro. Mowi was an early entrant in the salmon aquaculture industry and established a large grow-out operation before legislation was passed which limited farm size. In addition, it is involved in salmon marketing and has vast interests in salmon farming abroad.

The salmon export industry (as distinct from salmon production) is heavily concentrated. It is estimated that 15 companies handle 80% of production and 3 or 4 companies account for 50% of sales. The largest Norwegian salmon exporter is Skaarfish-Mowi. In 1989, it is believed that this firm handled approximately 30,000 tonnes of salmon.

Integration

Restrictions limiting ownership to one site have limited horizontal integration, and have consequently prevented firms from achieving economies of scale and lower per unit production costs. Evidence suggests that economies could be gained through shared management and administration, and greater purchasing power for feed and smolts which are the major direct costs of production. To mitigate the lack of horizontal integration, some farms have formed cooperatives with respect to purchasing and processing. The restrictions limiting majority ownership do not, however, limit minority ownership positions, and it appears that some industry participants have minority interests in many different companies.

Vertical integration in the Norwegian salmon farming industry is not pervasive. Again, government regulations limiting farm ownership have restricted processors from backward integration. Other regulations have meant that hatcheries and smolt producers are effectively unable to achieve forward integration. While the owner-operators of individual salmon farms are not prohibited from integrating vertically, few companies have the financial resources necessary to pursue such ventures, because of the small scale of their operations.

Some farms have primary processing facilities on-site, but most transport the fish to processing plants that are usually owned by marketing/export companies. Marketing companies frequently have purchase agreements or minority ownership in fish farms, in order to guarantee supply. These arrangements, in effect, provide some of the benefits of vertical integration. There are many different types of contractual agreements that have evolved between marketing companies and fish farms which vertically connect the companies.

Industry regulations restricting marketing have resulted in 80 licensed purchasers, versus 700 fish farmers, and have resulted in a fairly distinct separation between production and marketing. According to Trond Bjorndal, in his publication "The Economics of Salmon Aquaculture", this separation is detrimental from an economic perspective. He claims that fully integrated enterprises would have better quality control, and producers would be better able to react to shifts in market demand.

Foreign Investment

There is limited foreign investment in the Norwegian aquaculture industry, probably as a result of the restrictions on ownership. The only exception to this is Trow, the largest feed company which is majority owned by BP (though even here, 51% ownership must be maintained by BP Norway). In contrast, Norwegian investment in foreign fish farm operations is relatively high due to domestic governmental regulations which limit one firm or person to majority ownership in only one fish farm.

This factor, in combination with perceived expansion opportunities abroad, prohibitive tariffs limiting expansion into the European community, and personnel with fish farming experience and expertise, has lead to significant investment in salmon farming in other countries, particularly Canada.

A 1987 survey indicated that Norwegian companies were involved in 72 foreign operations in 15 countries. A 1989 issue of Atlantic Fish Farming indicates that Norwegian banks have some $70 million dollars invested in the British Columbia salmon farming industry. Moreover, in 1988, one industry observer claimed that 60-70% of the aquaculture industry in British Columbia was dominated by Norwegians.

Government Regulation and Support

The Norwegian Ministry of Fisheries exercises legal and administrative control over the fish farming industry, largely through the licensing process. In order to farm fish in Norway, one must possess a government issued license. These licenses specify location, maximum farm size, and ownership. Because of perceived high rates of return in the industry, competition for licences has been fierce. For example, in 1985/86 there were 150 licenses issued out of a total of 2,500 applicants. At present, there is a moratorium on the issuance of new licenses.

In terms of farm size, the government believes that the imposition of a maximum size limit encourages the development of small business and dispersed employment - political goals of the Norwegian government. In 1989 the maximum volume of production per licensee was raised from 8,000 M^3 to 12,000 M^3.

Another key licensing criteria is that a licensee may not hold a majority interest (greater than 50% ownership) in more than one fish farm. This has obviously limited the ability of companies to horizontally integrate, and has encouraged large fish farming enterprises to invest in operations abroad.

Prior to 1985, the government imposed onerous restrictions on smolt producers which resulted in a supply shortage. Regulation changes in 1985 have meant increased production of Norwegian smolts, although a regulation still exists which restricts maximum production capacity to one million smolts per hatchery. As a result of the regulatory changes, the Norwegian industry is currently trying to cope with a surplus of smolts. In fact, this year an estimated 26 million smolts will be killed.

The Norwegian government has provided the aquaculture industry with considerable financial support. Up to 1986, the Norwegian government channelled 1,279 Nkr million ($225 million) into salmon farming by way of loans, loan guarantees and grants. However, in 1986 the government made a political decision to limit direct funding to the industry.

The government has provided significant assistance to universities and scientific facilities for research and development, such as the Norwegian Fisheries Research Council which has a budget of some $5.6 million. Two other research councils are also funded by the government: the Norwegian Agriculture Research Council and the Norwegian Technology Research Council. Total government funding to aquaculture is in the region of $18.2 million (BC Salmon Farmers Association 1990).

Industry Associations

Salmon marketing, much like salmon production, is heavily regulated. In 1985 the Fish Farmers Sales Organization (FFSO) was formed; a body which regulates sales of Norwegian salmon and promotes orderly marketing. A primary objective of the organization is to provide small producers with increased bargaining power vis-a-vis purchasers, thereby maximizing market prices. The FFSO sets minimum prices for sizes and categories of salmon and has the ability to control sales by forcing farmers to hold or freeze their salmon.

By law all producers must be members of the FFSO. The organization is funded by a levy paid by both farmers and purchasers (export and marketing companies). All sales of salmon are administered by the FFSO which pays farmers on behalf of purchasers. The purchasers (exporters) also have an association, the secretariat of which is administered by the FFSO. Each member operator of the association pays a fee of 1 1/2% of sales revenue. There is provision in the constitution of the FFSO which specifies a minimum market price, below which salmon prices are not allowed to drop. The FFSO also controls prices by scheduling each farm's harvest in order to even out the supply of salmon to the market.

Ancillary goals of the FFSO are aquaculture research and development, product quality control, and advertising and promotion of Norwegian salmon.

Products and Markets

In 1985, the Norwegian government made legislative changes that resulted in a dramatic increase in the production capabilities of the hatchery sector. The increased production capabilities resulted in a huge increase in the number of smolts available in 1987. Production levels almost doubled between

1987 and 1988 as the first smolts of the hatchery expansion began to be harvested. In 1989, production rose over 25% from 1988 to 117,000 tonnes.

Production over the next few years is expected to slow as a result of bankruptcies of smolt producers, the FFSO's request that members restrict production, protectionist activities in Europe and the United States, and a moratorium on the issuance of salmon farming licenses.

In 1989 the total capacity of Norway's 790 salmon farms was approximately 9.5 million M^3 and average production was estimated at 250 tonnes/farm. Based on this average, potential production could be as high as 200,000 tonnes. However, lack of capital, depressed market conditions and a moratorium on licenses will likely limit production. For example, smolt production in 1988 was 77 million but is expected to decrease to 62 million in 1990. Hence, Norwegian salmon production is expected to decline from 150,000 tonnes in 1990 to 130,000 tonnes in 1992.

The Product

The vast majority of Norway's exports are fresh products. Most of the frozen product is sold to European salmon smokers. Japanese buyers are, however, purchasing an increasing amount of frozen product.

Atlantic salmon range from 1 kg to 10 kg, but the majority of output, 63%, is accounted for by salmon weighing between 2-4 kg. The following table demonstrates the division between sales of fresh and frozen salmon:

Table 8

Norwegian Exports by Product Type
1983 - 1988

	1983	1986	1987	1988
Fresh				
Tonnes	13,014	34,396	39,179	57,950
%	84	88	91	85
Frozen				
Tonnes	2,383	4,507	4,023	10,076
%	16	12	9	15
Total				
Tonnes	15,397	38,903	43,202	68,026
%	100	100	100	100

Source: Norwegian Trade Statistics

Recently a decline in quality has been detected in fresh salmon exports. Fat content and colour are two areas which have been identified as requiring improvement. The following table demonstrates the decline in production of superior quality fish.

Table 9

Norwegian Output by Quality Category
1985 - 1988

	1985 %	1986 %	1987 %	1988 %
Superior	90	83	79	76
Ordinary	8	13	17 (1)	20
Production	2	4	4	4

Note:

(1) This number has been adjusted upwards by Price Waterhouse as source document did not add to 100%.

Source: Shaw, and Gabbott, An International Study of Farmed Salmon, University of Oslo (1990)

In addition to fresh and frozen product, the Norwegian industry is also trying to expand into value-added products which typically yield higher margins. Increased sales of fillets, steaks and smoked salmon are anticipated over the next few years.

In the past, exports of value-added products were relatively low as a result of high tariffs placed on value-added products imported into the European community and fear of aggravating major European salmon smokers which purchase sizable quantities of Norwegian raw salmon. For example, in the French market approximately 65% of imported salmon is smoked, and 40% of this is Norwegian salmon.

Notwithstanding, it is expected that quantities of value-added salmon products will rise because of optimistic world demand projections for value added products and depressed world prices for whole salmon.

The Market

Norway is the world leader in terms of farmed salmon exports. In excess of 90% of total Norwegian production is exported. The following table indicates exports by destination:

Table 10

Destination of Norwegian Exports
1983 - 1988

Tonnes

	1983	%	1986	%	1987	%	1988	%
France	4,321	28	9,904	25	11,644	27	18,698	28
West Germany	2,387	16	4,671	12	4,921	12	7,493	12
Denmark	3,016	13	5,462	14	7,484	18	14,168	21
Sweden	794	5	1,916	5	1,684	4	2,767	4
United Kingdom	1,337	9	1,648	4	1,471	3	2,155	3
Switzerland	506	3	788	2	1,068	2	1,357	2
Belgium/Luxembourg	484	3	1,390	4	1,530	4	2,137	3
Spain	359	2	1,917	5	1,530	4	2,137	3
US	2,405	16	9,278	24	8,075	19	9,942	15
Japan	-	-	771	2	1,311	3	2,955	5
Others	788	5	1,158	3	1,886	4	2,453	4
Total	15,397	100	38,903	100	43,202	100	66,262	100

Source: Norwegian Trade Statistics

In the early 1980s, European countries were the main importers of Norwegian salmon, particularly France. Norway continues to be the primary supplier to European countries such as France, Denmark and West Germany, although, in recent years the US has become a major importer of Norwegian salmon. Statistics indicate that, of the 19,000 tonnes of salmon imported to the United States in 1987, 41% was supplied by Norway and 41% by Canada. However, recognizing the difficulty of competing effectively in the US market over the long term, due to lower transportation costs for Canadian salmon, the Norwegians are now focusing increased attention on marketing to Japan, the world's largest consumer of salmon. Furthermore, Norway is also facing anti-dumping charges and protectionist measures in the European Community and possibly also in the US.

Although Japan is the largest salmon market in the world, Norway exported only 2,500 tonnes to Japan in 1988, most of it fresh product. The Norwegian Export Council feels that the frozen product market has greater potential. The Japanese imported 120,000 tonnes of frozen salmon last year, and Norwegians hope to eventually export 30,000 frozen tonnes. To this end, the Marketing Council for Farmed Fish recently initiated an $8 million marketing program in Japan.

Marketing Activities

As discussed in prior sections, trade in raw salmon is managed by the FFSO. The FFSO manages this trade through the issuance of purchasing licenses and through stringent quality control measures. In 1989 there were approximately 80 licensed purchasers. Licensed purchasers are restricted to domestic marketing unless they are also awarded an export license.

Most exporters distribute their product through wholesalers. To date, exporters have expressed little interest in intervention further down the distribution channel. The Norwegian exporters have few customer contacts at the retail level and have found it to be more efficient to deal through third parties. In the United States, certain supermarkets prefer to deal directly with exporters, hence, a movement towards direct distribution is anticipated. However, in Japan traditional wholesalers dominate the distribution system, and third party distribution is expected to continue.

The FFSO's strategy of issuing purchase licenses was implemented to maintain price stability and provide small growers with increased bargaining power vis-a-vis the export companies, although it is debatable as to whether the FFSO has achieved these goals. The FFSO sets minimum prices for sizes and categories of salmon and has the ability to control sales by forcing farmers to hold or freeze their salmon. In addition, international promotion of Norwegian salmon is managed by FFSO, although it is augmented, to some extent, by the marketing efforts of certain export companies.

Although there are legitimate criticisms of the FFSO, in general, the marketing organization appears to have operated very successfully. Under the direction of the FFSO, Norway has grown to be the largest exporter of farmed salmon in the world and has a reputation for high quality. The FFSO spends more on advertising and promotion than any other farmed salmon marketing organization. However, early marketing efforts were directed towards establishing salmon as a luxury food item worthy of premium prices. Recent evidence indicates that in order to sustain market share and industry profitability, salmon may have to be re-positioned to appeal to a wider spectrum of consumers. Hence, the FFSO may have to re-evaluate its current marketing strategy.

In an effort to differentiate their products, branding has been undertaken by some exporters, largely through the use of gill tags and specially labelled boxes. This trend is expected to accelerate.

Prices

Because Norway is the largest salmon producer, its prices strongly influence world salmon prices. The price of Norwegian Atlantic salmon is the benchmark against which most industry observers compare other prices. Salmon prices in Norway are set by the FFSO. The FFSO sets minimum prices for different sizes and quality of salmon, and can revoke the licenses of salmon farms which sell below the minimum established price.

The FFSO has only limited control over production which makes it difficult to enforce a price which is not in equilibrium with the supply and demand for salmon. The FFSO can refuse to invoice sales or request that farmers hold or freeze product, but it is difficult for an organization to request that farmers delay harvesting fully grown salmon or freeze salmon in spite of low demand for frozen product and higher handling costs.

Market prices have, until recently, been substantially higher than minimum price levels as a result of high demand. During the early years when the industry was growing, it was easy to ensure that producers complied with the minimum selling prices. However, in 1989 prices dropped by some 30% (see appendix 1-2) as producers started selling below the minimum price level. In fact, the Scottish and Irish fish farming industries have accused the Norwegian industry of selling product below cost. This allegation is currently being investigated by the EEC. If the Norwegian industry is found guilty, a penalty tax on Norwegian salmon could be imposed.

In 1989 and 1990 the FFSO embarked on a large scale salmon freezing operation which eventually froze some 30,000-35,000 tonnes. The intention of this effort was to reduce the supply of fresh salmon, thereby creating a better balance between supply and demand which would result in higher and more stable prices. Although prices have rebounded somewhat in 1990, the action was very successful. Price stability, at the required level was achieved from January 1990. However if production volumes of other countries increase, Norway may be unable to exercise the same degree of influence over world prices in the future.

Economic Performance

Salmon farming dominates aquaculture production in Norway and contributes significantly to the Norwegian economy. The total value of 1988 production was 3.4 Nkr billion ($583 million). In 1988 direct and indirect employment exceeded 10,000 people.

Costs of Production

Norwegian production costs are currently very difficult to obtain because of the anti-dumping action that has been launched against the Norwegian industry: the Scottish and Irish industries along with American producers have accused the Norwegians of selling salmon below cost. Therefore while the case is being investigated by the EEC and the US, accurate cost information is difficult to secure.

One estimate of average production costs for farmed salmon is as follows:

Table 11

Cost of Production in Norway
Based on Full Capacity Utilization
1989

	Unit Costs/kg.		
	Nkr	**$**	**% Cost**
Smolt	4.16	.71	16
Feed	10.70	1.84	40
Wages	2.40	.41	9
Fish insurance	1.50	.26	6
Interest on working capital	1.34	.23	5
Total variable costs	20.10	3.45	76
Fixed costs	3.56	.61	13
Interest and depreciation	2.94	.50	11
Production costs/kg	26.60	4.56	100

Note: 1 Nkr = $0.1716, average annual exchange rate, Royal Bank of Canada.

Source: Bjorndal, The Economics of Salmon Aquaculture, Blackwell Scientific Publications (1990)

However, this analysis is predicated on many assumptions including the following:

Smolt price 13 Nkr
Mortality 15%
Conversion ratio 1.3
Production 250 tonnes

Any change in these assumptions would impact significantly on production costs. If, for example, the production volume were to rise to 375 tonnes and smolt prices were to fall to 9 Nkr, production costs would fall to 23.56 Nkr. (for more detailed analysis and discussion of assumptions, refer to the source document).

There is some variance between these estimates and those produced by the Norwegian Directorate of Fisheries based on a survey of 281 farms (see appendix 6). The variance between the above cost estimates and those supplied by the Directorate of Fisheries is thought to be due to the fact that many of the farms included in the government's sample were not yet fully developed and therefore were not yet operating at full capacity. For example, the government's study reports smolt costs per unit of 9.42 Nkr versus 4.16 Nkr. Smolts are not harvested until one or two years after purchase, however, they are accounted for in the year of purchase. Consequently, when a producer is in an expansionary phase, costs/kg are overstated. In the governmental study, most growers were expanding production, therefore certain costs such as smolts and fixed costs are overstated.

A more recent estimate of production costs is shown below. These costs were calculated by the FFSO in 1990.

Table 12

Cost of Production in Norway
Based on Full Capacity Utilization
1990

	Unit Costs/kg. Nkr	Unit Costs/kg. $	% Cost
Smolt	3.64	0.62	15
Feed	10.80	1.85	44
Transport and marketing	2.77	0.48	11
Labour	2.22	0.38	9
Administration	1.44	0.25	6
Interest and depreciation	2.27	0.39	9
Other	1.32	0.23	6
Production costs per kilogram	24.46	4.20	100

Note: 1 Nkr = $0.1716, average annual exchange rate, Royal Bank of Canada.

Source: FFSO, Paul Torgnes

The table shows a similar breakdown of costs to that produced by Bjorndal.

Norway's location places it at a comparative disadvantage in terms of exporting to certain destinations such as the US Air freight costs of approximately $2.80/kg from Norway to the Northeastern US make it difficult for Norwegian salmon to compete effectively with Eastern Canadian farmed salmon on the basis of price.

It should be noted that the costs of producing salmon vary between geographic regions. Some industry observers estimate that the cost of producing salmon is two to three times higher in northern Norway than in southern Norway. There are several reasons for this. Many of the companies in northern Norway are still in a start-up phase which increases costs. Also, lower water temperatures mean slower growth rates; and smolts, feed supplies and processing are more expensive because of higher transportation costs due to remote site locations.

The tremendous growth in the industry has created a shortage of working capital. The FFSO believes that the credit required to relieve the shortage in working capital from 1989 to 1992 will be some $7.7, $8.4, $9.4 and $11.2 billion, in each respective year. Similar to the situation in most producing nations, Norwegian farmers are experiencing cash flow shortages and have resorted to advancing their harvest schedules to meet financial deadlines. This in turn, has upset market equilibrium and contributed to the downward price spiral experienced in 1989.

Some notable bankruptcies have occurred in Norway including Saga Seafoods and Fremmestad, two of the larger industry operators. It would appear that smaller operations, which generally have a higher proportion of equity to debt, may be more financially resilient.

Capital Costs

Based on an 8000 M^3 sea farm with floating capability, the estimated cost of establishing a fish farm facility is as follows:

Table 13

Capital Investments in Norway

	Nkr	$
Float	825,000	141,570
House	270,000	46,332
Feeding Equipment with Silo		
Generator, watertank, hydrofor (installed)	600,000	102,960
Gangway	150,000	25,740
Anchoring	100,000	17,160
Float with equipment	200,000	34,320
	2,145,000	368,082
Pens (10 pens)	1,180,000	202,488
Transportation, installation and anchoring	200,000	34,320
Nets (30 ft x 10 ft)	300,000	51,480
Safety equipment	120,000	20,592
Cranes/winches	50,000	8,580
Sea-pen system	1,850,000	317,460
Boats	175,000	30,030
Miscellaneous	80,000	13,728
Total investments	4,250,000	729,300

Note: 1 Nkr = $0.1716, average annual exchange rate, Royal Bank of Canada.

Source: Bjorndal, Trond, The Economics of Salmon Aquaculture, Blackwell Scientific Publications (1990)

Inherent in these projections are many assumptions that are subject to change. For example, some operations have established technologically sophisticated operations which require much larger capital expenditures than those represented in this analysis. Based on Dr. Bjorndal's analysis, facility investments are lower in British Columbia, but the lower stocking density in British Columbia necessitates the purchase of a greater number of pens.

Industry Outlook

The rise in Norwegian farmed salmon production during 1989, in combination with large North American wild salmon catches, has been cited by many industry observers as the cause of the dramatic decline in world salmon prices. As in other countries, 1989 ushered in financial difficulties for many Norwegian companies. Accordingly, the Norwegian industry is currently in a transitional phase. In 1989, 19 hatcheries and 9 cage farms closed and closure rates were expected to continue over 1990/91. One industry observer believes that most of Norway's hatcheries are at present either insolvent or at least in an unstable financial position, expecting that between 50 and 75 additional hatcheries would close in 1990/91. An estimated 26 million smolts will be killed this year to limit smolt production to 62 million.

To combat these financial problems, Norwegian production is expected to slow markedly over the next several years.

The Marketing Council for Norwegian Salmon predicts the following production rates:

1990	150,000 tonnes
1991	140,000 tonnes
1992	130,000 tonnes

This production slowdown will result from three primary factors:

- The FFSO has requested that their members transfer no more than 80,000 to 100,000 smolts a year to grow-out sites. Furthermore, Norwegian banks are making compliance with this request a criterion for future credit to farmers;
- The Norwegian Directorate of Fisheries has imposed a moratorium on the issuance of farm licenses;
- Fewer smolts will be available as a result of the closure of many existing hatcheries.

In order to sustain the industry, the FFSO has already bought over 30,000 tonnes of salmon. Norwegian farmers are guaranteed a minimum price for the fish and the operation is expected to cost approximately 1.7 billion Nkr ($300 million). Frozen salmon is sold through ordinary channels at full price or stored until such time as sufficient demand exists. The FFSO has determined that it will not sell below market price.

Strengths and Weaknesses

Strengths

- There are an almost unlimited number of locations for aquaculture in Norway as a result of a long coastline with fjords and islands that protect fish farms from heavy weather.

- Norway has a well-established aquaculture tradition and is regarded as the world leader in salmon farming. Infrastructure to support the industry is well developed and there is an adequate supply of trained workers and aquaculture researchers.

- Although there are legitimate criticisms of the FFSO, in general, the marketing organization appears to have operated very successfully. Under the direction of this organization, Norway has grown to be the largest exporter of farmed salmon in the world and Norwegian salmon has a reputation for high quality. The FFSO spends more on advertising and promotion than other countries and these expenditures have been credited with increased sales of farmed salmon abroad.

- Norwegian banks and the Norwegian government have, in general, been very supportive of the industry. However, this support has receded since 1986.

- Norwegian salmon has a strong reputation for high quality, largely as a result of the FFSO's stringent quality control program.

Weaknesses

- Intense salmon cultivation increases the likelihood of disease. In 1985, Norway suffered a loss of salmon due to an outbreak of Hitra disease. Disease control and prevention programs are now in place in an effort to limit the outbreak of new diseases.

- Production statistics indicate that the quality of Norwegian salmon has been declining somewhat.

- Air freight costs of approximately $2.80/kg from Norway to the Northeastern US make it difficult for Norwegian salmon to effectively compete with Eastern Canadian farmed salmon on the basis of price.

- Norwegian water tends to have higher pollution levels from salmon pens than the waters of certain other producing nations such as Canada and Chile. This is possibly due to an excess concentration of salmon farms in small geographic areas.

- Norway has not yet fully examined the opportunities to market value-added products. Although, the FFSO has indicated that it intends to spend more time and effort to exploit this market.

- The Norwegian industry is heavily regulated. Regulations preventing horizontal and vertical integration may limit the industry's ability to achieve economies of scale and thereby attain the lowest possible production costs. Also, fully integrated enterprises would have better quality control, and producers would be better able to react to shifts in market demand.

Salmon Farming in Chile

Historical Development

Salmon are not native to Chilean waters. The earliest introduction of salmon occurred in the early 1970s. Efforts to grow the species in Chilean waters have been ongoing since then. (La Salmonicultura en Chile, p.195-206).

Interest in introducing salmon to Chile rose significantly in the mid-1970s because salmon farming was proving successful in the Northern hemisphere. Similarities between water and weather conditions in Chile and regions of North America generated renewed interest in introducing salmon to Chile.

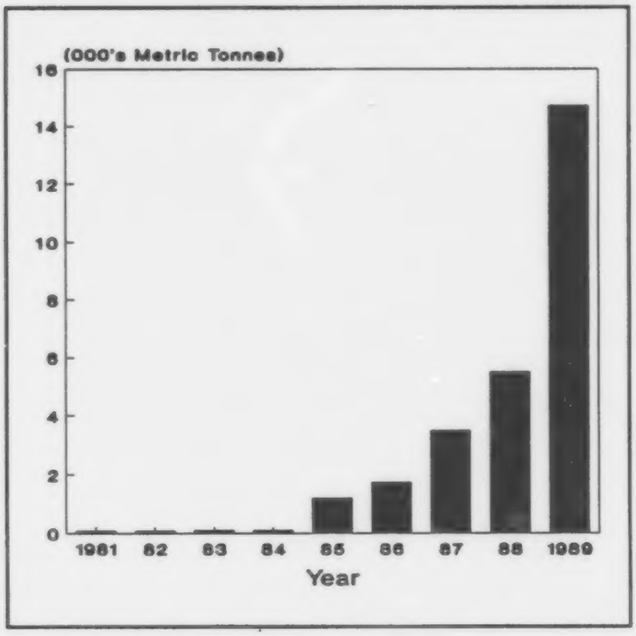
The establishment of Chilean salmon farming as a commercial industry benefitted greatly from the Chilean government's economic policies of the 1970s. The government provided funding for research and development efforts, taxation and public spending policies favoured business, and incentives for new export industries were put in place. (La Salmonicultura en Chile, p.195-206).

Salmon farming in Chile commenced in 1979. Fundacion Chile initiated much of the early research and development of salmon farming. Fundacion Chile is a joint venture between the Chilean government and the ITT Corporation. Its mandate is to develop new Chilean industries by providing venture capital, technical and management skills. If a Fundacion Chile business or enterprise becomes viable, it is then sold.

In 1981 Fundacion Chile purchased Domsea Fisheries which it renamed Salmones Antarctica. The successful creation of Salmones Antarctica motivated several small producers to enter the industry. In 1981, 70 tonnes of salmon were harvested. The decade has brought tremendous growth and Chile now ranks as the world's sixth largest salmon producer. The following graph demonstrates the phenomenal growth of the salmon farming industry in Chile: (See appendix 7 for more detail).

Salmon Production in Chile
1981 - 1989

Chart 6



Industry Structure

In general, there are minimal restrictions involved in leasing a farm site. Although the majority of growers have only one approved site, there are a few companies that have developed five or more sites. It is estimated that there are currently between 250 and 300 marine and freshwater sites in Chile; estimates vary because many companies which have obtained site permits have not yet made any efforts to establish grow-out facilities. The Department of the Undersecretary of Fisheries, which licenses all sites, allows lease holders twelve months before they are forced to begin making use of the site or risk losing their site permit.

Salmon aquaculture is concentrated on the Southern Coast of Chile. The coastline is similar to Norway's with fjords; small islands and inlets which provide protection from severe weather conditions and waves. In addition, strong tides in the region provide excellent water quality. The premium quality water may be a result of less industrial pollution, possibly because of the relative lack of industrialization.

Over 90% of salmon production is currently concentrated in Puerto Mont, the island of Chilce, and to a lessor extent Chacabuco Bay, near Port Aysen. Other suitable culture sites exist but the absence of suitable infrastructure has limited the industry's development in other jurisdictions. The transportation infrastructure in rural Chile is undeveloped relative to other producing nations.

Since 1984, there has been a dramatic increase in the number and size of salmon farms. However, growth has slowed drastically over the past year. At least four companies discontinued operations in 1989; either through receivership or takeover by larger companies. Industry analysts believe that concentration will escalate as worldwide output increases. The concentration will be less pervasive than in British Columbia however, because Chilean growers are not burdened with as much debt and costs of production are lower.

Statistics for 1988 indicate that there were 72 companies involved in salmon farming. As is the case in other producing nations, producers range from very small Chilean companies to large multinational corporations. Of these companies, 28 are individually owned farms, while 11 sites are operated by public concerns such as academic institutions and branches of government.

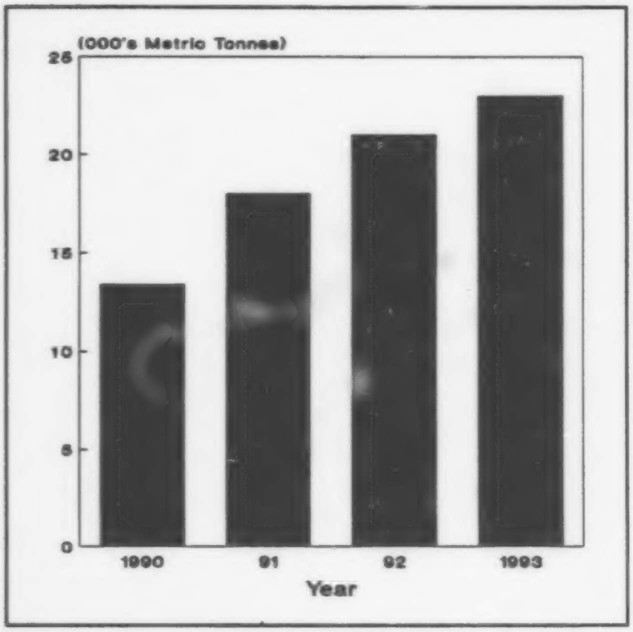
The four largest companies are Mainstream, Salmones Antarctica, Unimarc and Marine Harvest. It is estimated that these companies each harvest between 1,300 and 1,500 tonnes per year and during the 1988-89 season they harvested approximately 50% of total Chilean production. In contrast, approximately two thirds of those Chilean farmers authorized to farm salmon in sea water have a planned capacity of no more than 300 tonnes of fish per year.

Production

The following chart illustrates the projected growth of the salmon farming industry in Chile. (See appendix 8 for detailed statistics.)

Projected Output in Chile
1990 - 1993

Chart 7



These production levels are, however, dependent upon world prices for salmon. If salmon prices decline any further, these forecasts will necessarily be revised downwards. The Chilean Salmon Farmers Association is advocating a strategy of maintaining production levels, while expanding demand and this strategy is reflected in the forecast figures. Exports of salmon products surpassed $US 32 million between January and June 1989.

Integration

Backward vertical integration is more common than forward integration. In addition to rearing salmon, most of the large producers have their own hatcheries and in some cases their own feed mills. The early establishment of hatcheries was vital as the Chilean industry was completely dependent on imported eggs for its survival, which was risky and not cost-effective. Even now, smolt production is heavily dependent on imported eggs as Chilean egg production is still inadequate. Government records indicate that over 20 million eggs were imported to Chile between December 1987 and March 1988. Despite a national broodstock program, local production accounts for only 15-20% of the industry's egg requirements.

In terms of forward integration, certain large producers have established processing and packing operations near their production sites. Forward integration has become important because of the shortage of the necessary infrastructure to freeze, process, or transport large volumes of fish.

Unlike large producers, small growers have not vertically integrated their operations to any significant extent, probably due to lack of capital for financing. Furthermore, as a nation, Chile is short of foreign exchange and importing capital equipment is prohibitively expensive, which has further limited expansion for companies which lack the backing of larger parent companies. Smaller producers purchase smolts and contract out the processing of their fish.

Government Regulation and Support

A key feature which differentiates Chilean aquaculture from aquaculture in other jurisdictions is the relative lack of government intervention in the industry. This philosophy has created a favourable environment for foreign investment.

The primary body responsible for regulating the Chilean industry is the Department of the Under Secretary of Fisheries, which licenses all production sites. The only major regulation enforced by this department is that grow-out sites be spaced 1.5 km apart, with the exception of Chacabuco Bay.

The Chilean government's support of salmon farming has been vital to the successful establishment of the industry. Fundacion Chile initiated much of the early research and development of salmon farming. Carfo, a government institution which promotes the development of Chilean industry through the granting of credit and loan guarantees, has also been very supportive of Chilean aquaculture. Because of low rates of return in the industry, however, Carfo has over the past few years severely restricted its support of the industry.

Foreign Investment

The salmon farming industry has fewer restrictions than other countries and enjoys relatively low taxation rates and import duties, although the flow of profits abroad is somewhat restricted. These factors have contributed to the high level of foreign ownership in the aquaculture industry: most of the larger companies are foreign owned. Originally the US was a prominent investor, but over the past decade ownership has become more diverse.

Marine Harvest is one of the largest foreign operators in Chile and is owned by the British and Dutch conglomerate Unilever. British Petroleum owns Mainstream, while Nippon Suisan Kaisha Ltd. of Japan owns Salmones Antarctica. Salmones Antarctica was reportedly sold to Nippon Suisan Kaisha by Fundacion Chile in 1988 for $US 25 million. Unimarc is a subsidiary of a Chilean parent company.

In contrast, ownership of the smaller growers is mostly domestic, although joint ventures have been fairly popular over the past three to four years, particularly with Scottish, Norwegian, Canadian and American firms. The impetus for development in this industry by foreigners was predicted high rates of return, which in many cases has not been realized due to low world prices for salmon. Consequently, consistent with other salmon farming nations, foreign investment in the industry has slowed dramatically.

According to 1987-88 data, investment requirements per tonne of production in Chile are practically half of those for Canada, 35% of those in Norway and 32% of those in Scotland. (Fundacion Chile, 1989). The Association of Chilean Salmon Farmers estimates that total investment in the industry is approximately $US 70 million dollars.

Trade Associations

The Chilean Association of Salmon and Trout Producers is the primary trade association. It is three years old and was set up by five principal salmon producers. Concerned about the industry's erratic and disorganized development, this group was formed to encourage efficient and systematic industry growth and marketing. The association currently has approximately 40 member companies, about 75% of salmon growers. The Association's current goals are:

- to ensure premium product quality;
- to promote culture techniques which minimize disease;
- to promote Chilean salmon worldwide;
- to provide producers with current world price information; and
- to lobby the government on behalf of the industry.

Products and Markets

The Product

Most of the salmon farmed in Chile is Pacific coho. This species has adjusted well to the Chilean climate and water conditions and yields one of the highest salmon growth rates in the world. Production during the 1988 - 1989 season was 80% to 85% coho.

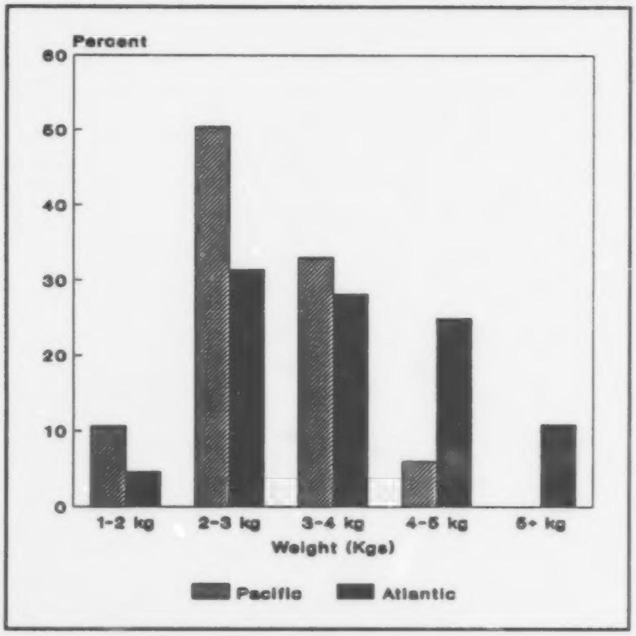
The culture of Atlantic and chinook salmon in Chile is rising, however, and it is expected to be at the expense of coho. Although final figures are not available, it is expected that coho will represent only 60% to 65% of the 1989-1990 harvest. Particularly remarkable is the sudden and sizable shift towards production of Atlantic salmon. The primary reasons for the shift towards Atlantic salmon are: ease of rearing at sea and an extended harvest period (October through May). In contrast, coho have to be harvested just before maturity, which is approximately 18 months after being placed in sea cages. Thus, there is much less flexibility with respect to harvest season.

Based on statistics supplied by the International Salmon Farmer's Association, the 1990 production of Atlantic salmon increased from 1,770 tonnes in 1989 to 4,900 tonnes in 1990.

The size breakdown of production is as follows:

Production of Salmon by Size in Chile
1989

Chart 8



The greatest proportion of fish exported from Chile is sold whole, head on or head off. As an increasing volume of fish is shipped to Japan, the proportion of frozen fish is rising: the Japanese buyers favour salmon in whole frozen form. At present smoked salmon is consumed domestically, but exports of this product are negligible. However, a subsidiary of Fundacion Chile is building a new smoking facility with a capacity of 100 tonnes. The presence of this facility should stimulate increased exports of smoked salmon. Moreover, because of the depressed salmon market, processors are expressing greater interest in producing value-added products such as smoked salmon, fillets and single serving portions.

Prices

In January 1990, the average price delivered for superior salmon as reported by the Chilean Salmon Farmers Association, was $US 7.20/kg, for fresh, gutted, 3-4 lb Atlantic salmon and $6.83/kg for 2-3 lb Pacific salmon. This is consistent with price information presented in appendix 1-2 which shows 4-6 lb Chilean coho selling for $US 6.60/kg ($US 3.0/lb). Prices in 1990 are lower than prices paid in earlier years. For example, 4-6 lb Chilean coho was reported selling for $US 9.70/kg ($US 4.4/lb) in December 1987, a 32% drop from that reported for January 1990 (see appendix 1-2).

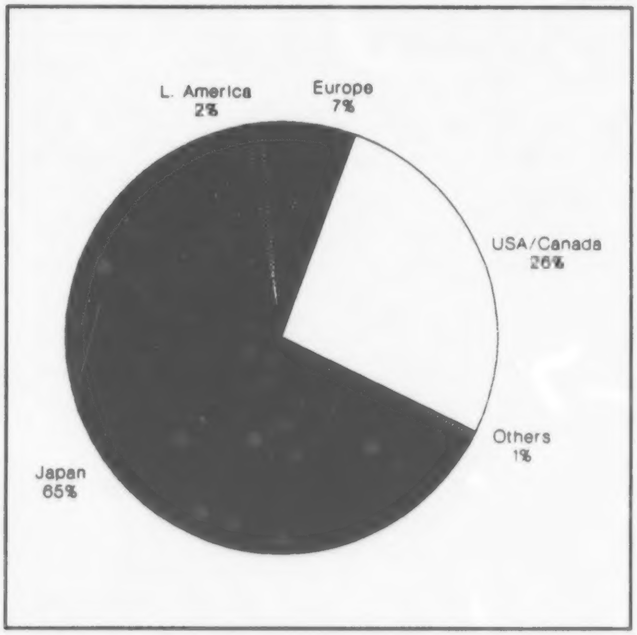
According to the marketing manager of the Chilean Salmon and Trout Farmers Association, current prices mean that many Chilean producers are just breaking even. He believes that if Norway meets its forecast production level of 150,000 tonnes of salmon in 1990, many small Chilean producers will be forced out of the industry or will merge with larger operators.

The Market

The two major export markets for Chilean salmon are Japan and North America, in particular the US. The following table illustrates the percentage of exports destined for various markets:

Chilean Exports by Destination
1989

Chart 9



Until 1987, the US was the largest market for Chilean salmon. This is due to the relative proximity of the U.S. to Chile, the vast size of the US marketplace, and the Southern hemisphere's reversed seasons. Because the harvest season in Chile is from December through March, Chile is not forced to compete with North America's wild salmon season, although an increasing quantity of farmed salmon is becoming available. Furthermore, the US market is very large, which has meant that for many years Chile was not forced to secure other export markets. The US currently ranks second behind Japan as an export market for Chile salmon.

The main species sold to the US is coho, although the proportion of Atlantic salmon being sold is increasing. There are advantages to rearing Atlantic salmon versus coho for Chilean farmers and there is a definite shift towards rearing Atlantic salmon. In fact, Chile imported 16 million Atlantic salmon eggs in early 1990.

In 1987-88, Japan overtook the US as the primary export market for Chilean salmon. The Japanese started to express an interest in Chilean salmon during 1986-87, as Chile began to market sufficient quantities to supply Japan with salmon during the winter season. During the 1988-89 season, sales to Japan accounted for 70% of total sales and between January and April 1989, 82% of all salmon exported during that period went to Japan.

The high cost of transporting fresh salmon to the US is one of the key reasons for shipping to Japan. Japanese buyers appear to favour frozen product, and in some cases have been willing to pay more for frozen salmon than the US is willing to pay for fresh salmon. Chileans like selling to Japan, as it is much less expensive to transport frozen than fresh product.

Because of Chile's very heavy dependence on only two nations, the US and Japan, several Chilean producers are eager to develop markets in Europe in an effort to reduce risk through diversification. However, because of high transportation costs, import tariffs and established suppliers in Norway, Scotland and Ireland, it is unlikely that Chile will achieve notable success in the short-term. At present salmon exports to Europe are comprised predominantly of smoked salmon to France and Holland. Also, some producers hope to increase domestic consumption. It is estimated that only 1% of production is consumed domestically, due to the relatively low level of domestic income.

Marketing Activities

Over 70% of fresh sales to the US market are made to seafood importers which demand 1 year supply contracts that specify quantities, quality and delivery dates. Some US importers have agents in Santiago or Puerto Montt, which co-ordinate distribution of the product. Most Chilean producers appear to have neither the expertise nor the desire to become involved with marketing their products directly, therefore this means of marketing their salmon appears to be mutually satisfactory.

Those salmon farmers affiliated with multinational corporations, however, do occasionally undertake their own marketing. To a limited extent, US brokers are used by some of the smaller producers.

Distribution channels for Chilean salmon in Japan are fairly structured. It would be very difficult for Chilean producers to sell direct, as companies from other countries have tried to do so with very little success. Approximately 90% of sales to Japan are based on contracts with a relatively small number of importers, but the Japanese sales contracts are far more particular and demanding than American sales contracts. In particular, Japanese buyers impose very strict quality criteria. To date, the Japanese importers have seemed very satisfied with the quality and price of Chilean salmon and are expected to continue to demand Chilean produced salmon. Most business is conducted in Japan.

Salmones Antarctica has the closest links with the Japanese market. However, all of its marketing is handled by its Japanese the parent company. Several of the other large producers have made some efforts to establish a brand identity, rather than being identified as a commodity - Chilean salmon. These large producers have their own marketing and promotions departments and publish brochures and promotional literature to promote brand awareness. The difficulty in establishing brand loyalty is that once the salmon is unpacked, the brand can not be identified, therefore it is very difficult to impose brand recognition. To circumvent this problem, certain growers are attaching gill tags that identify brand name. Small producers rely on the Chilean Salmon and Trout Producers Association to promote Chilean salmon as a commodity.

Economic Performance

Costs of Production

Unfortunately, there is not a great deal of information available on the current cost of production data for farmed Chilean salmon. Companies are reluctant to release financial information and no recent published surveys are available. There are two studies available based on 1987 costs, but, it is difficult to make inferences based on this data for several reasons. In 1987 many Chilean salmon farms were still in a start-up phase. Also, the period of 1987 - 1990 has seen a dramatic increase in feed and smolt costs, and a moderate increase in labour costs.

In general, however, it appears that costs are somewhat lower than in other producing nations. The following table was presented in a March, 1988 study prepared by The DPA Group Inc.:

Table 14

Unit Cost of Production of Coho Salmon in Chile
1987

	Unit Costs/kg $ US	% Cost
Variable Costs		
Smolts	0.19	6
Feed	1.21	38
Stock insurance	0.10	3
Processing	0.50	16
Interest on working capital	0.18	6
Total Variable Costs	2.18	69
Fixed Production Costs		
Wages	0.60	18
Overhead	0.26	8
Depreciation	0.09	3
Interest on capital	0.07	2
Total Fixed Costs	1.02	31
Production Costs per kilogram	3.20	100

Source: Cost of Production Model for Pen-Rearing of Salmon in Alaska and Currently Producing Regions, State of Alaska Department of Commerce and Economic Development (March 1988)

It is important to note that the above analysis does not include transportation costs which can be very high given Chile's location relative to its export markets. The March 1990 issue of World Aquaculture reports production costs varying between $US 2.80 and $US 3.30, although presumably this figure also excludes transportation costs.

According to the October 1989 issue of Fish Farm News, Salmones Chiloe is among the lowest cost producers in Chile. Their estimated cost of production is $US 4.50 to $US 5.00/kg landed in the United States. This estimate appears to be reasonable based on research conducted on worldwide salmon production costs by Dr. Ted Needham of DPA Consultants. Dr. Needham estimates that Chile's production costs (F.O.B. first selling point), 1989, were approximately $5/kg. Based on this estimate it appears that Chile and Norway have comparable per unit costs and are vying for lowest cost producing nation.

Labour is the one area of production where Chile enjoys an undisputed competitive cost advantage. Unskilled workers are paid between $US 120 - $US 140/month, while managers are paid approximately $US 20,000. Because of relatively low labour costs, labour intensive husbandry techniques prevail in Chile. For example, many growers feed and process salmon by hand and hand-built wooden cages are used as opposed to cages fabricated from metal or plastic. Low labour costs, and heavy import taxes on capital equipment, have also resulted in reduced capital spending on equipment. This fact is reflected in lower interest costs and lower depreciation. Lower interest costs have been a key reason why Chile's industry has not been plagued with as many bankruptcies and receiverships as the British Columbia industry. However, high turnover has been a problem in the industry which has offset some of the benefits of reduced employee wages. Also, there are indications that wage rates in the industry are rising, thus, the industry will have to continually re-evaluate the balance between labour and capital.

Chile is the second largest producer of fish meal. Because fish meal is a world commodity, however, its cost to Chilean producers is not a great deal lower than that paid by growers in other countries. Cost savings are realized because the costs of transporting feed is less. Dry pelleted feed costs approximately $US 0.85/kg with an approximate conversion rate of 1.9. Wet feeds are half this price and have an estimated conversion rate of 3.4. A higher conversion rate for the dry feeds minimizes the effective price differential.

Transport costs to the US market for fresh product vary but during the 1988-89 season the cost of shipping salmon from Santiago to Los Angeles was $US 1.60/kg, $US 1.30 to Miami, and $US 3.80 to Tokyo. Transportation costs are high because December through March is the busiest cargo season and salmon must compete with fruits, vegetables, and flowers for cargo space. The high transportation costs are another reason that Chilean producers favour sales of frozen product to Japan. The costs of transporting frozen product to Japan can be as low as $US 0.35/kg. (Shaw and Gabbott, 1990).

Furthermore, in certain producing regions there are many poor quality roads which can be very problematic. This is particularly true in the area south of Puerto Montt. Also, the distances from some of the southern fish farms to transportation centres are prohibitive, therefore air and ferry transport are frequently used. The absence of a developed infrastructure results in increased transportation costs and is particularly troublesome in view of the importance of fresh product.

Capital Costs

As discussed above, the Chilean salmon farming industry is relatively labour intensive. Consequently, capital expenditures are lower than other producing nations.

Based on 1987 data, the initial investment in fixed assets for floating cage sea farming ranges between $US 1,000 and $US 1,500/tonne of farmed product, assuming capacities between 100 and 300 tonnes. This does not include facilities for slaughtering the fish. (Fundacion Chile, 1987)

The initial total investment per harvested product tonne (1987 data) ranges between $US 2,800 and $US 4,150. That is, the total capital requirements for a floating cage fattening product of 200 tonnes per cycle would be near $US 500,000, while a 300 tonne project would cost about $US 830,000. It should be noted, however, that these estimates could vary dramatically depending on farm capacity, operational methods, and degree of automation. (Fundacion Chile, 1987) Based on these figures, the Fundacion Chile estimates that investment requirements per ton of production in Chile are only 30-50% of those necessary in Scotland, Norway and Canada.

Industry Outlook

The Chilean industry has exhibited phenomenal growth and Chilean salmon appears poised to capture an even larger world market share. The industry has some strong competitive advantages such as low labour and capital costs, favourable growing conditions and the ability to supply the North American market with fresh product during the off-season for the North American wild fishery.

Strengths and Weaknesses

Strengths

- Relative to other producing nations, Chile has the lowest labour costs. Because labour costs are low, Chile's salmon farming industry is very labour intensive, hence, producers have not required large capital expenditures for automation. Consequently, it appears that Chilean farmers have lower debt loads and are not as vulnerable to interest rate fluctuations.

- Chile pays marginally less for fish feed than other countries. Chile is the world's second largest producer of fishmeal and the world's largest exporter of fishmeal. Although the price differential is not that large (perhaps in the range of 20%), as the price of fish meal is set on the world market. Chile's advantage is that it its producers have lower transportation costs.

- The off-season for the North American wild fishery (November through May) corresponds with the Chilean harvesting season (December through March). Therefore, Chilean farmed salmon is available in the North American market when demand is high but supplies are relatively low.

- The Chilean industry has few restrictions and the government has favourable foreign investment regulations.

Weaknesses

- There is a higher degree of political uncertainty in Chile than in other producing nations. Investors have no assurance of a stable political environment or future government support for the salmon industry. Whether future regimes will support free trade or restrict capital investment and foreign ownership could impact the industry's development.

- Chile has been slow in establishing facilities for smoking salmon, therefore, although there are some sales of smoked salmon domestically, limited export markets for smoked salmon have been developed.

- There are still a significant number of small producers that are unable to take advantage of economies of scale, consequently if world prices remain depressed they could be in financial difficulty.

- Its two main markets are the US and Japan. These markets are being aggressively pursued by other producers New Zealand and Australia are becoming involved in fish production, and also possess the Southern hemisphere advantages.

- The EEC and US threat to put up trade barriers could make it more difficult for Chile to effectively compete in these markets after 1992.

- Margins for coho farming are extremely tight. This weakness should diminish as companies continuing to farm coho go into receivership and others move rapidly to farming Atlantic salmon.

Salmon Farming in Scotland

Historical Development

The introduction of salmon farming to Scotland occurred in the mid-1960s. Unilever, an English-Dutch multinational, financed research into finfish aquaculture and determined that salmon aquaculture along the west coast of Scotland could be viable. In 1973, Marine Harvest, a subsidiary of Unilever, produced 50 tonnes of salmon, thereby spawning the interest of several other Scottish companies seeking to diversify their interests.

The industry was slow to develop because of the hesitancy of financial institutions to extend credit to an industry with unknown rates of return. Furthermore, in the early years salmon farming in Scotland was difficult; disease and low survival rates were initially very problematic. Marine Harvest operated for fifteen years before it showed a profit.

However, in the late 1970s, the Highlands and Islands Development Board (HIDB) which was founded in 1965 to stimulate economic and social development began supporting the industry's development in an effort to diversity the region's economy. Between 1977 and 1987, the HIDB invested almost $40 million dollars in the industry, approximately 25% of the total investment in salmon farming in this region. The support provided included research and development projects, financial incentives, extension services and marketing and promotion programs. Industry growth was stimulated in the Western Isles through $9.4 million in financial assistance from the Integrated Development Program (IDP), a five year funding program from the European Economic Community.

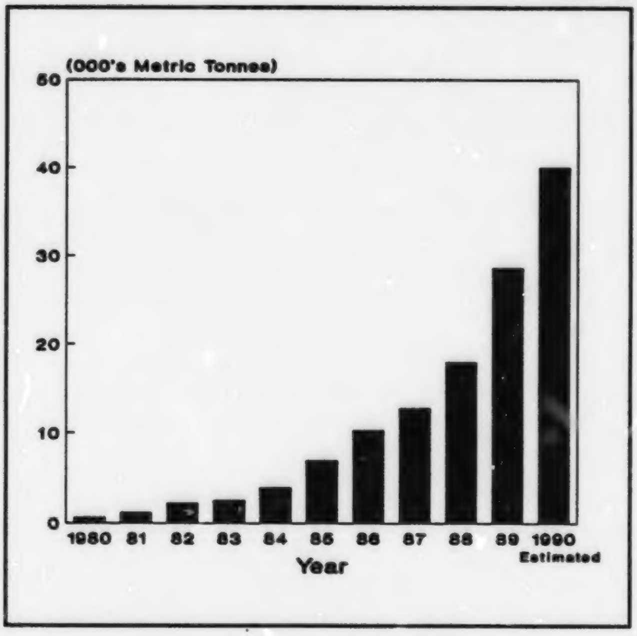
Significant quantities of Scottish farmed salmon were not available until the early 1980s, but since that time growth in production has been dramatic. In 1989 total production of salmon was 28,500 tonnes.

Industry Structure

The following chart indicates the growth in output experienced over the past decade (see appendix 9 for more detail):

Salmon Production in Scotland
1980 - 1990

Chart 10



Production is expected to continue growing, but the rate will be impacted by economic factors such as world salmon prices. Limited site availability may further limit industry growth in the long term.

Marine Grow-Out Operations

Unlike Norway, there are no legal restrictions on the size of salmon farms in Scotland. Initially, large companies were predominant, but by 1989 there were 331 sites of varying size and capacity.

Unlike Norway, the Scottish industry is characterized by a mix of small and large companies. In general, salmon farms can be divided into two categories:

- Small growers which originally produced volumes of approximately 20 to 50 tonnes, but now produce between 100 and 300 tonnes. It appears that 100 tonnes is the minimum level necessary for economic viability. In 1986, 87 of the 97 producing companies generated output in this range and their production accounted for 29% of total output.
- Larger producers generally produce greater than 300 tonnes. In 1986, there were approximately 10 firms in this category; three of which accounted for 50% of production.

As the industry has grown, there has been a trend towards increasing production capacity. The average site production capacity in 1985 was 85 tonnes but increased to 96 tonnes in 1988. There are indications that economies of scale exist particularly in the areas of labour and capital costs, although their nature and extent are still uncertain.

Major Company Profiles

The three largest Scottish salmon producers are Marine Harvest, McConnell Salmon and Golden Sea Produce.

Marine Harvest the largest Scottish producer, and the largest producer world-wide. In 1988, its output was in excess of 5,000 tonnes from 18 sites. Its 1990 production is forecast to be greater than 10,000 tonnes. Marine Harvest introduced salmon farming to Scotland over twenty years ago.

McConnell Salmon is a subsidiary of the multinational firm Booker McConnell. In 1988, the company produced 1,900 tonnes from 14 sites.

Golden Sea Produce is a subsidiary of Norsk Hydro and is thought to be comparable to McConnell Salmon in terms of size.

Concentration

Together, the three major companies described above account for some 50% of total production with the remaining 50% of output being generated by small and mid-sized companies.

The number of new entrants increased steadily throughout the 1980s until 1988, at which time a shortage of suitable sites slowed entry into the industry. The 1989 decline in world salmon prices further inhibited the entry of new competitors. Some smaller companies are expected to increase their production capabilities in order to reduce average costs and, hopefully, achieve economies of scale. However, apart from this, the current degree of industry concentration is expected to remain unchanged.

Integration

In Scotland, there is a relatively high level of vertical integration between hatcheries, smolt producers, marine grow-out operations, and processing. The nature and extent of integration varies significantly between companies.

While many companies specialize in farming salmon, there are many others which are integrated forwards into processing. The large companies, such as Marine Harvest, are all fully integrated. Marine Harvest is even involved in secondary processing such as enclosing salmon in specialized packaging for retail consumption. Smaller operators tend to sell their harvest to trading companies which own processing facilities. Most major producers produce smolts: some use the smolts exclusively for their own grow-out operations while others sell excess smolts to other growers.

Foreign Investment

The restrictive salmon farm ownership regulations imposed by the Norwegian government have resulted in considerable investment in the Scottish industry by Norwegian interests. Golden Sea Produce, possibly the third largest producer in Scotland, is owned by Norsk-Hydro, a large Norwegian multi-national firm. Many smaller firms have also received funding from Norwegian interests.

Government Regulation and Support

The Scottish regulatory environment is notable in that there is no central governing body responsible for regulating the aquaculture industry. For example, site authorization is granted by the Crown Estate Commissioners, pollution regulations are enforced by the River Purification Boards, while various government ministries regulate share responsibility for monitoring sea traffic, disease control, and fish processing. There is a voluntary code of practice for husbandry and processing which has been established by the Scottish Salmon Growers Association and association members generally comply with these recommendations. Unlike Norway, the government imposes no restrictions on farm size or ownership.

Similar to the Norwegian industry, aquaculture in Scotland has been strongly supported by the relevant levels of government. The Highland and Islands Development Board (HIDB) has invested the equivalent of nearly $40 million in the industry through loans and grants. Two European Economic Community (EEC) programs, FEOGA and IDP, have also provided funding to the industry.

Industry Associations

Two key organizations currently represent Scottish salmon farmers:

The Scottish Salmon Growers Association (SSGA)

This association was formed in 1982 and represents salmon farmers in the mainland of Scotland, the Orkney Islands, and the islands west of Scotland. Although membership in the Association is voluntary, virtually all of the large producers are members and members' production accounts for over 80% of total industry production.

The SSGA is financed by a levy on smolts purchased. The levy is of £0.13 ($0.28) and was expected to generate $6.3 million in 1989.

The Shetland Salmon Farmers Association (SSFA)

For many years, the Shetland salmon farmers were members of the SSGA, however, in 1985 they withdrew from this organization and formed their own association, the Shetland Salmon Farmers Association (SSFA). All Shetland salmon farmers are members.

The SSFA split from its parent organization for several reasons. Shetland salmon farmers believe that a separate and distinct image will enable them to continue commanding premium prices in the world salmon market. Because of a stronger quality control system and larger fish, Shetland salmon is generally perceived to be superior to most Scottish reared salmon.

Membership in either of the industry association's is voluntary and neither has legal authority to impose limits on price, output or capacity. In general, both organizations have similar objectives. Both groups seek to provide information and advice, maintain high quality standards, promote Scottish salmon, and liaise with governmental bodies on behalf of the industry.

Support Sectors

Despite the absence of a large wild fishery, Scotland now has well developed aquaculture support sectors. There are numerous equipment suppliers and an adequate supply of trained personnel. In the early years of the industry, there was a shortage of skilled and experienced labour but this problem was shared by most countries. The University of Stirling, Institute of Aquaculture was established in 1971 and has an excellent reputation world-wide. The Institute has over 100 staff, a post-graduate school of 70 from 25 countries and a budget exceeding £3 million. In addition there are several aquaculture training courses including a new Bachelor of Technology Aquaculture course will be offered in autumn 1990 at the North of Scotland College of Agriculture.

Products and Markets

Products

The salmon reared in Scotland are exclusively Atlantic and are sold in a number of forms:

Table 15

Scottish Sales by Product Type

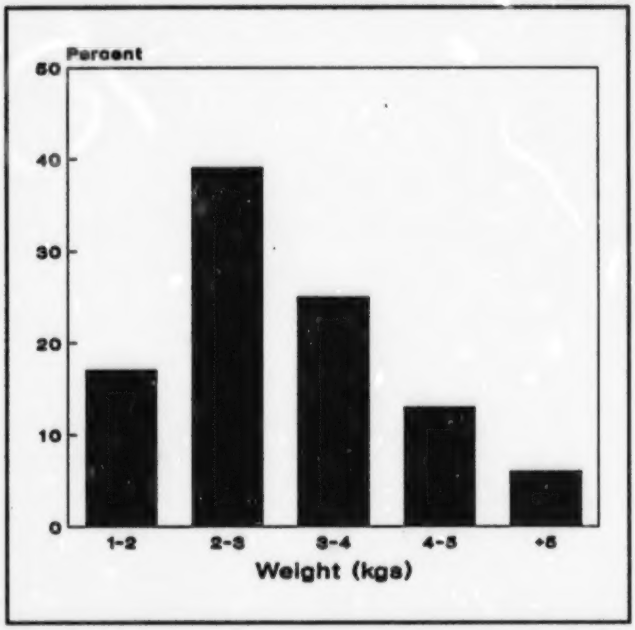
Primary Products	Distribution of Output
Whole, fresh, gutted and ungutted	over 90%
Whole fresh fillets and steaks	less than 5%
Frozen salmon	approximately 1%

Source: Shaw and Gabbott, An International Study of the Marketing of Farmed Salmon Report No. 05/1990, Norwegian School of Economics and Business Administration, Department of Economics, University of Oslo (1990)

Although there do not appear to be any recent statistics available which identify the size of salmon sold, assuming that sales and production are roughly proportionate, the following figures provide an estimate of the size of U.K. salmon sold:

Production by Salmon Size in Scotland

Chart 11



It is worth noting that 57% of the fish harvested in 1987 were harvested after only one year in sea water (grilse). High grilse rates have been a source of concern, particularly in the Western Isles, as they can lead to lower weights and lower sale prices.

Scottish salmon is available throughout the year, which has given it an advantage in the marketplace. Pacific salmon producers such as Chile and British Columbia have less flexibility, although Chile will gain this capability as it moves towards production of Atlantic salmon.

In comparison to other producing nations, Scotland has been more active in developing and marketing value added products. Smoked salmon, individual sized portions in controlled atmosphere packs, marinated salmon, pates, and other specialized products are presently being developed and marketed by the Scottish industry.

A large proportion of salmon exports, possibly in the 50% range, are smoked. Consequently, Scottish producers are endeavouring to provide smoking companies with salmon that meets their exact specifications. Lately, certain salmon smokers have been requesting a product with lower fat content, hence, many Scottish producers whose salmon is destined for smokers are endeavouring to raise lower fat salmon.

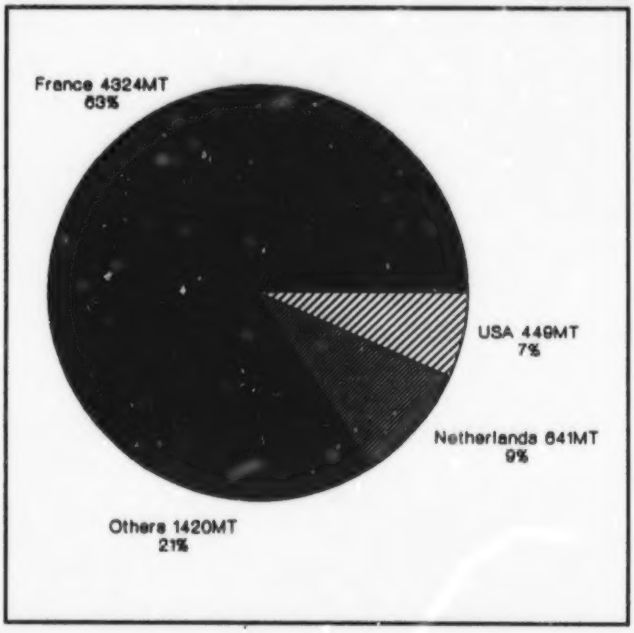
The Market

The most striking observation concerning the markets supplied by Scottish salmon farmers is the very high level of domestic sales. It is estimated that in 1988 the U.K. market consumed approximately 60% of total production. A strong domestic market is a benefit to the Scottish industry in that transportation costs are low and the industry is protected from exchange rate fluctuation. Salmon has traditionally been a canned food item, however, a consequence of the close proximity of the Scottish salmon farming industry has been the development of a large market for fresh salmon.

Export markets include the European Economic Community (EEC) and the US. France is the largest export market, and approximately 50% of exports to France are used for smoking. As a member of the EEC, Scotland is protected from the tariffs imposed on Norway when exporting to France and other members of the EEC. Because processed foods face the highest tariffs, 13% in the case of salmon, this is a strong competitive advantage.

Major Export Markets for Scottish Salmon
1988

Chart 12



Note: Only 40% of Scottish production was exported in 1988

Source: Current Development in World Salmon Markets: Implications for the Canadian Salmon Farming Industry. Economic and Commercial Analysis Report No.46, Department of Fisheries and Oceans

Marketing Structure and Activities

Salmon farmers have changed the nature of their role in the marketing process. They have become much more organized and have formed various types of marketing groups. Over 50 producers are members of some type of marketing structure, ranging from farmer-owned marketing companies to long term contractual arrangements with trading companies. The objective of all of these arrangements is to increase the individual farmer's relative power by forming a larger group. Also, wholesalers and importers prefer these arrangements because they are afforded greater continuity of supply and greater ranges of sizes and consistency of quality.

Creation of marketing groups has been encouraged by the Scottish Salmon Growers Association and the Shetland Salmon Farmers Association.

As a result of the increased presence of marketing groups, the number of selling points in the industry has declined from 90 to 10, within the past two years. Selling points are places at which processed, boxed salmon are available for sale. In general, this has been regarded as a positive change as sellers have greater power in the marketplace, prices are more stable, and quality and supply are more consistent. Although there has been a concentration on the marketing of farmed salmon, there are still numerous channels of distribution.

A study conducted by The Department of Agricultural and Rural Economics, North of Scotland College of Agriculture revealed the following channels of distribution for production based on a random sample of 22 farms:

Table 16

Distribution Channels for Scottish Salmon Production
1987 - 1989

Type of Outlet	% of Sales
Associated Marketing/Processing Company	9
Co-operative Marketing/Processing Company	18
Other Producer Involved in Marketing/Processing	4
Marketing Agent	32
Direct to Wholesale Markets (e.g. Billingsgate)	8
Direct to Wholesaler/Processor	13
Direct to Smoker	15
Direct to Consumer	<0.5
	100%

Note: May not add due to rounding

Source: Smith, and Sutherland, "Costs and Returns from Farm Salmon Production in Scotland 1987/88 and 1988/89", The Department of Agricultural and Rural Economics, North of Scotland College of Agriculture

Unlike producers in other nations, many Scottish growers have established relationships with small wholesalers and retailers and deliver directly to retail outlets. This strategy is possible because of a large domestic market.

In this survey, eleven producers graded, boxed and iced the product. A co-operative marketing company performed that task in one case and the remainder supplied bulk salmon, either selling the fish in that form, or contracting-out the grading and boxing to a fish processor.

Sales and Promotion

The Scottish Salmon Growers Association (SSGA) has responsibility for advertising and promoting Scottish salmon and is funded by a levy on smolts purchased. In 1983, the Scottish Salmon Growers Association budget was £45,000 ($99,000) whereas it is expected to rise to $1.9 million ($4.2 million) in 1989. (In 1983, the SSGA contribution was accompanied by a further £0.5 million provided by the HIDB, aimed at launching the organization and underwriting it for the first 5 years of operation.)

The SSGA has two primary objectives:

(1) generic marketing and promotion; and
(2) marketing quality Scottish salmon.

Although a high proportion of current output is already consumed by the domestic market, the SSGA still anticipates growth in this market. At present, per capita consumption is approximately 0.3 kg, only one third of French per capita consumption. It is to this market that the industry is directing its generic marketing campaign. Also, efforts at securing export sales have increased, particularly those directed at France and the United States. The European market is a particularly desirable target because Scotland is protected from import tariffs.

Scottish salmon producers have endeavoured to introduce some product branding through the use of distinctive boxes. It appears that only Marine Harvest is attempting to establish branding through the use of gill tags. In general, the large producers have been much more active in sales and promotional activities than smaller firms. Marine Harvest has sales offices in New York, Paris and Tokyo.

The largest per capita consumers of salmon are the Japanese. Although the Norwegians have a strong hold over the Atlantic salmon market in Japan, the SSGA still believes that there is room for Scottish salmon farmers to establish a market niche, particularly for processed and value added products. This gives the Scottish industry a competitive advantage in the Japanese market.

Competition

As indicated earlier, an interesting characteristic of Scottish salmon farming is the large proportion of product that is consumed domestically. In the U.K. market, Scottish salmon competes with wild salmon from Ireland, the Faroes and Iceland, as well as some Norwegian farmed salmon. Salmon imports between 1980 and 1988 have increased proportionately less than domestic production. The

U.K. also imports some Pacific salmon from Canada and the United States, although the volumes are diminishing.

Competition in European export markets is primarily from the Norwegians but in the US and Japan, Norway, Chile and Canada are emerging as the key competitors.

Economic Performance

In 1989, farm gate output of salmon was estimated at £120 million. While the industry has exhibited healthy growth for several years, the decline in world salmon prices has resulted in financial hardship for many Scottish salmon farmers.

Scottish fish farmers have been the most vocal opponents of Norway's increased production and have lodged formal complaints with the EEC against the Norwegian industry. The Scottish Salmon Board maintains that Norway has been selling salmon below cost, a violation of anti-dumping regulations.

Based on extrapolation of a survey conducted by Sutherland and Smith of Aberdeen's North of Scotland College of Agriculture, in 1989 the average Scottish salmon farm suffered losses equal to 30-40% of total production costs. It also appears that mainland farmers have suffered much heavier losses than producers in the Shetlands or the Western Isles. This may be due to poorer growing conditions on the mainland, hence lower survival rates. Consequently, some industry observers believe that mainland growers have weaker husbandry skills which contributes to their problems.

A serious problem for fish farmers in Scotland, the mainland in particular, is smolt mortality. One report indicated that smolt survival has dropped to approximately 70%, lower than other key producing nations. Department of Agriculture and Fisheries statistics for 1989 demonstrate that the industry is losing at least 10% more tonnage than might be expected based on prior year survival records. Currently, 550 smolts are required to produce one tonne of salmon, as opposed to 300 to 400 smolts per tonne in Norway. The Scottish industry will continue to face a serious cost disadvantage unless it can resolve this problem.

A further problem is that of mean weight of harvested salmon. Statistics for 1989, compiled by the Department of Agriculture and Fisheries, show that from the 1988 smolt intake, the average fish weighed 2.6 kg, while the recorded mean weight from the 1987 smolt intake was 2.62 kg and for 1985 it was 2.95 kg. The 1988 recorded mean weight was the lowest ever and was possibly due to disease and management marketing decisions. Mean weights at harvest should increase from 2 kg (current weight) to at least 3 to 3.5 kg, in order to reduce per unit costs. Smaller salmon are sold at reduced prices.

Costs of Production

A detailed study of the costs and returns from farmed salmon production was conducted by The Department of Agricultural and Rural Economics, North of Scotland College of Agriculture. This document outlines detailed costs of production based on a random sample of 22 sea farms owned by members of the Scottish Salmon Growers Association and Shetland Salmon Farmers Association. Total salmon sales by all companies participating in the study amounted to 11,682 tonnes, approximately 60% of Scottish production.

The study indicates that between 1987/88 and 1988/89 (based on a May to April production year) there was a significant reduction in profitability, primarily due to a 16% decrease in the average price paid for salmon. Furthermore, rather than decreased unit costs over the period, unit costs actually increased due in part to increased mortalities and sale of fish at lower average weights.

The actual published results are presented in much greater detail in the source document and have been summarized by Price Waterhouse as follows:

Table 17

Average Costs of Production in Scotland
(May 1, 1988 - April 30, 1989)

	£	$	% Costs
Smolts	0.745	1.579	22
Feed	1.051	2.227	31
Labour	0.515	1.091	15
Insurance	0.110	0.233	3
Other Operating Costs	0.592	1.254	17
	3.013	6.384	88
Depreciation	0.270	0.572	8
Interest	0.122	0.259	4
Total costs per tonne	3.405	7.215	100 %

Note: Based on average exchange rate over the 12 month period of £1 = $2.1190

Source: Sutherland, and Smith, "Costs and Returns from Farm Salmon Production in Scotland 1987/88 and 1988/89". The Department of Agricultural and Rural Economics, North of Scotland College of Agriculture.

It should be noted that cost definitions and a detailed discussion of survey methodology are contained in the original report and should be reviewed before inferences are drawn based on these costs. It is important to note that production costs differ remarkably between the major salmon farming regions. In 1988/89, the mainland's costs were £3,730/tonne ($7,903) Shetland's costs were £2,982/tonne ($6,318), and the Western Isle's costs were £3,535/tonne ($7,491). (Sutherland and Smith, 1989). Relative to other producing regions such as Chile, Norway and British Columbia, mainland Scotland appears to have the highest production costs.

Capital Costs

The following chart details capital investment costs in Scotland: a simple overall mean is presented, which incudes costs in mainland Scotland, the Shetlands and the Western Isles.

Table 18

Capital Investment Costs Per Tonne of Production in Scotland

Simple Overall Mean

	$	$	%
Stock Valuation	2,161	4,843	59
Cages, Nets and Moorings	619	1,387	17
Machinery and Equipment	380	852	10
Buildings, Roads, Jetties	232	520	6
Total Capital	3,392	7,602	92
Return on Capital	<2.1%>	<2.1%>	<2>
12% Interest on Capital	407	912	10
Total Costs (including interest on capital)	3,690	8,269	100

Note: Based on exchange rate effective at September 13, 1990 of £1 = $2.241

Source: Sutherland, R., and Smith, J., Costs and Returns from Farm Salmon Production in Scotland, 1987/88 and 1988/89 (1989)

The chart illustrates the problems which arise when capital investment costs are analyzed. Though simple mean total cost is some £3,690 ($8,269) the simple mean ranges from £4,014 ($8,995) on the mainland to £3,231 ($7,241) in the Western Isles. On the other hand, the Shetlands have mean total costs of £3,869 ($8,670), close to the simple mean, but has a considerably low stock valuation, and higher investment in cages, nets and moorings than the other two regions of Scotland.

The figures above should be used as indicators only of capital investment costs. Extreme caution should be taken in attempting to draw conclusions from the figures.

Financing

Data collected for the Scottish Salmon Board, the Department of Agricultural and Rural Economics, reveals some information on capital structure. Based on balance sheets of 21 businesses, the average capital structure is as follows:

Table 19

Capital Structure of an Average Salmon Farm in Scotland

	£'000	$	%
Sundry Creditors and Other Liabilities	534	1,080	19
Bank Overdraft	211	427	7
Commercial Loans	94	190	3
Private Loans	1,478	2,989	52
Equity	538	1,088	19
Total Assets/Liabilities	2,885	5,833	100

Note: Based on average exchange rate for April 1989 of £1 = $2.022

The equity percentage appears very low at 19%, but when combined with private loans, the total is 71%.

17 companies included in the sample received funding from U.K. sources amounting to £1.5 million or an average of £67,500 per company sampled. Eight firms received grant assistance from the European Community totalling £568,000 or £25,800 per company sampled.

Bank involvement in the early stages of the industry was insignificant: Marine Harvest Ltd., the firm which introduced commercial salmon farming to Scotland, provided all of its own early financing. Support from the public sector increased in the late 1970s with loans and grants from the Highlands and Islands Development Board (HIDB), and two EEC programs, the IDP and FEOGA. Between 1977 and 1987, the HIDB invested almost $40 million dollars in the industry, approximately 25% of the total investment in salmon farming in this region.

It was not until the mid-1980s that banks began lending to fish farms, following the impressive returns on investments of the early 1980s. In addition to the unproven nature of the industry, a further impediment to obtaining institutional financing has been uneven cash flow. With the exception of very large companies, most salmon farms generate cash in only the first and fourth quarters.

Because of the current state of the industry, it will be very difficult for companies to raise additional financing for expansion.

Industry Outlook

Depressed world prices have led to a situation where many Scottish producers are losing money. Based on a study of Scottish costs of production, returns in 1988/89 were 30% lower than the prior year, and most farms were losing money. Though consumption is expected to increase in Europe, output is also forecast to rise by 20% and excess output could continue to exacerbate supply and demand disequilibrium. On the other hand, supply and demand could increasingly come into balance in 1990 and 1991 thus improving the market position for producers.

In the long term, however, prospects are brighter. Scottish farmers are optimistic that free trade within the EEC in 1992 will be an important advantage. Controlled Norwegian output is an important step towards maintaining higher salmon prices. However, there are still some concerns about the effect of fish farming on the environment. In particular, the use of chemicals and the danger to wild stocks of escaped farm fish have been highlighted.

Strengths and Weaknesses

Strengths

- Although it makes salmon rearing more difficult and costly, the heavy rainfall and strong tides have been credited with providing high quality clean water in which to raise salmon;
- Scotland and Ireland are members of the European Economic Community (EEC) and can thereby avoid paying the tariffs confronting non-EEC members;
- Scottish salmon is available throughout the year, whereas those producing regions that grow predominantly Pacific salmon, such as British Columbia and Chile, are not yet able to provide year round supplies;

- Scotland appears to be more active than other producing countries in developing and marketing value added products.

- The levy on smolts in inventory appears to be an effective means of generating promotional funds. The budget for promotion in 1990 may expand to $12.2 million or two percent of sales; and

- Scotland has a large domestic market which reduces transportation costs and insulates producers from exchange rate fluctuation.

Weaknesses

- There is a lack of suitable and available farm sites. Some areas remain that could be cultivated, however, they lie in less sheltered areas, and costs of production would be much higher. Given current economic conditions, there has been little interest in establishing facilities in these less desirable locations; and

- Salmon weight has been declining, which has resulted in lower salmon prices; and

- Smolt mortality is high, which results in higher production costs.

International Comparisons

Over the last ten years, Canada has grown to become the world's fourth largest producer of salmon behind Norway, Scotland and Japan and on a par with Chile. World production of farmed salmon has increased dramatically in the last few years and has exerted downward pressure on prices. This was exacerbated by record wild salmon catches such that prices for farmed salmon fell by some 30-40% over the last two to three years (see appendix 1-2). This has placed tremendous pressure on producers in all countries.

The following section accepts that global changes are taking place in the salmon farming industry which affect all producers. It focuses on a comparison between the aquaculture industries in Eastern and Western Canada with those in Norway, Scotland and Chile. The discussion is based on the assumption that the Canadian industry can learn important lessons from experiences in other countries.

Industry Structure

Industry structures vary greatly between countries. To some extent, the differences can be explained by the stages of growth reached by each: Norway and Scotland are relatively well-developed, with initial start-up problems and second stage rationalization well underway. On the other hand, the industry in Chile and Canada is still in the very early stages of development. Some of the most instructive lessons concerning the efficiency and effectiveness of various industry structures can therefore be learned from Norway and Scotland given that the salmon farming industry is considerably older in these two countries.

Although quantitative information is lacking, industry experience in Norway and Scotland suggests that there are very few economies of scale to be gained at the **production** level (by having larger individual farms). The reasons for this are:

- the smaller the operation, the easier it is to contain costs and to control individual factors of production (this is particularly important in the context of current world markets where margins have been reduced to a minimum); and
- technology used in small and large operations is essentially the same.

Large operations do not appear able to purchase key inputs, such as feed or smolts, at significantly lower prices than small operations although quantitative information is not available. Vertical integration can, however, provide security of supply. The ability of companies to supply their own inputs through vertical integration and/or secured operations may be a key success factor in the future. Vertically integrated firms may not be subject to the high input prices that external suppliers (some of which are direct competitors) could force upon them.

The Norwegian industry appears to draw strength from the predominance of small producers, though there are several large integrated firms. The structure of the Norwegian industry encourages a high level of efficiency. The structure of the Scottish industry is also shifting in favour of the smaller operations. Concentration has been much greater in Scotland than in Norway but in recent years, considerable increases in smolt mortality and in operating costs were experienced and were thought to be the result of increased concentration. Discussions with industry specialists have suggested that, as a result, a number of larger Scottish operators are beginning to decentralize in an effort to contain and control costs more effectively.

On the other hand, research has shown that there are considerable economies of scale **downstream** in the transportation of salmon for processing, in processing, and in marketing of the final product. Both Norway and Scotland do have a considerable degree of concentration in areas where economies of scale can be reaped: in Norway, production of the smaller operator is frequently taken, processed and marketed, by larger firms; in Scotland, generic marketing functions have been taken on by the SSGA and the SSFA which serve all farmers in the industry (though not all farmers are members).

In British Columbia, the initial start-up of the salmon farming industry began with a proliferation of small operators. This has given way to massive rationalization: small firms proved unable to survive the price decline of 1989/90 and the industry is becoming increasingly concentrated as receiverships continue to redistribute assets towards the larger firms. However, it should not necessarily be assumed that size was the key factor in these failures: leverage, start-up costs, technical difficulties and inexperience are other factors which should also be considered.

Given these recent developments, it is useful to consider the structure of the industry in Norway and the recent developments in Scotland because these provide indicators as to the most productive direction for the industry in British Columbia. It is possible that concentration at the farm level could be detrimental to the industry as a whole by reducing control over production costs (especially given the recent fluctuations on the world market and the squeezing of margins). Efforts could be made to retain decentralized operating units and to keep costs of production under control even with the concentration currently taking place in the industry (as is happening in Scotland). On the other hand, in British Columbia there has, as yet, been relatively little realization of the economies of scale which exist at the processing and marketing level. Considerable advances could be and are being made in this direction either through integration or through the establishment of cooperatives and industry organizations.

The salmon farming industry in Eastern Canada (primarily in New Brunswick and Nova Scotia) has grown in a much more orderly fashion than that on the West coast. There is a considerable degree of cooperation among operators in buying, processing and marketing functions, thus allowing all salmon farmers to take advantage of economies of scale: in many cases, the larger integrated firms perform these functions for smaller operators.

Government

In all the countries covered by this report, the government has been involved, to some degree, in the growth and development of the salmon farming industry. The discussion here will be divided into two sections, regulation and support:

Regulation

The primary goal of the government in the regulation of the salmon farming industry has differed substantially between countries. In Norway the industry is highly regulated, with governments setting licensing and locational requirements. These have tended to ensure that the industry has developed in conformity with the political, economic and social goals of the government: the encouragement of small operators in remote regions of the country where salmon farming is one of the only means of support for rural communities. Licences have not played as big a role in Scotland. Here, government control is exercised through a number of Ministries with diverse interests and mandates, and it has therefore tended to be more disjointed. However, in general, regulation is perceived to be relatively benign and the government has generally encouraged the development of the salmon farming industry.

In Western Canada, the federal Department of Fisheries and Oceans and the provincial government are perceived by individual operators as regulatory and restrictive. This is largely because government regulations control farming at the operational level to accommodate the demands of a variety of interest groups all competing for use of coastal resources, not least the wild and recreational fisheries. Managing the needs of these groups has placed pressure on the government to determine efficient and equitable allocation of resources. Both governments have also been involved in restrictions on importation of Atlantic smolts and eggs into the province.

East Coast salmon farmers have also had to conform to rigorous environmental and locational regulations. In Nova Scotia, the planning review process involves some nine provincial bodies and public hearings should this be necessary. Similarly, applications for licenses in New Brunswick are put before an intergovernmental review committee before being considered by the Minister and must conform to number of Acts concerning legislation other than aquaculture. In relative terms, the industry on the East Coast has a high degree of government regulation.

In contrast, the salmon farming industry in Chile has remained with virtually no regulations. The government does require that farms are adequately spaced but this constitutes the only real restriction on farming operations. This helps to explain why foreign investment in the Chilean industry has been such an attractive prospect.

Support

In Norway, Chile and Scotland, government has played a significant role in the establishment of the salmon farming industry. In contrast, Western Canada has received less financial government support than any other region cited in this report, despite the fact that the British Columbia salmon farming industry is still in a developmental phase. Also, the British Columbia industry has been unable to draw on commercial bank loans from Canadian banks, as a result of the interpretation of salmon farm assets by British Columbia banks: fish inventories are not considered assets and cannot, therefore, be used as collateral for loans. The reverse is true in Eastern Canada where domestic banks have provided support to the salmon farming industry. In Western Canada, commercial loans have been available but primarily from Norwegian banks.

Governments in Western Canada have provided little substantial financial assistance to salmon farm operators. This contrasts strongly with Scotland where, in the initial start-up phase of the industry when bank loans were insignificant, the government played a major role in the development of the industry. Similarly in Chile, the government has provided funds for research and development, has instituted taxation and spending policies to benefit the small business, and has favoured export industries. In this case, the problems faced by a new salmon farming industry were mitigated by positive government policies, something which has not been seen in Western Canada.

This is not to argue that substantial government investment is now needed in the salmon farming industry in Western Canada. Indeed, most of the government support provided in other countries was instrumental in the start-up of the industry, but was of less importance once the industry had become established. Given that the salmon farming industry is now established in the West of Canada, government financial support at the production level is not necessarily the most effective way of strengthening the industry in the long term. The one exception to this could be the establishment of salmon farms in remote areas. Should the priority be to encourage development of the industry in outlying northern areas, government support would be essential.

Government support in Eastern Canada has been considerably higher than that in the West. Financial and in-kind support has been provided by both the federal government (primarily in the form of ACOA grants) and the provincial government departments responsible for aquaculture in Nova Scotia and New Brunswick.

Products and Markets

Two factors concerning the product itself are important in the context of the performance of the salmon farming industry: the species farmed and the nature of the end product supplied to the market. These are dealt with in the section below. Important distinctions in marketing approaches are also discussed.

The Product

Species

Ultimate returns in the salmon farming industry can be greatly affected by the species farmed. There are important biophysical differences between the Atlantic and Pacific salmon which lead to variation in salmon size at harvest, market value for end product and operational costs. Atlantic salmon has considerably better production characteristics than Pacific salmon:

- Atlantics grow to a larger weight, faster;
- Atlantics have a lower feed conversion ratio; and
- the Atlantic salmon has a lower mortality rate after smoltification.

Furthermore, the Atlantic salmon has been farmed for considerably longer than the Pacific salmon and techniques are therefore better researched and established. These advantages outweigh the higher price associated with Atlantic smolts. The Norwegian and Scottish salmon farming industries farm only Atlantic salmon. In Chile, though coho has been the primary species to date, considerable quantities of Atlantic eggs and smolts are now being purchased and there is a shift away from Pacific salmon.

The salmon farming industry in Western Canada has concentrated on Pacific species, primarily chinook, and has therefore been unable to benefit from the advantages of Atlantic salmon farming. To a large extent, this was the result of government regulation which restricted imports of Atlantic smolts into British Columbia. This has placed it at a disadvantage when competing with large Atlantic salmon which can both command a higher selling price because of its larger average size, and can be produced at lower unit costs (given feed conversion ratios and relative smolt costs per unit of product).

More recently, there has been a trend towards Atlantic salmon farming in British Columbia which, according to figures produced by the B.C. Salmon Farmers Association, is expected to grow over the next few years. The trend should lead to an improvement in the market price of the British Columbia product and a decrease in unit costs of production. On the other hand, the emphasis in Eastern Canada on Atlantic salmon has allowed the industry there to make considerable use of the research and development on Atlantic salmon and to compete on the same basis as producers in Norway and Scotland: producing larger fish, with a higher market value at somewhat lower unit costs of production.

Marketing Strategies

One of the major shifts in marketed product has been the increasing emphasis being placed on the development of value-added products. Proponents of the value-added product would argue that they help to maintain healthy profit margins and that they are an important way to expand and develop a wider consumer base and new markets. There are also those who hold the opposite view and believe that margins are not necessarily increased with value-added products and, indeed, margins can actually fall as processing costs rise. In general, the salmon farming industry in all the countries covered by this report, seems to be moving in favour of increasing the output of value-added products. Similar trends are evident in most other types of food production.

Scotland would appear to have moved the furthest down this path as increased quantities of salmon are smoked, sold in individual portions, vacuum wrapped, used to make pates, and are processed into other specialized products. Chile is also developing value-added products, as is Norway, though they have developed less rapidly than in Scotland.

There have been similar moves towards development of value-added products in Eastern Canada where these products are shipped throughout the US, but it remains true that the majority of the Eastern Canada product is sold fresh. Though there is now discussion in Western Canada about the potential of value-added products, the lack of centralized marketing and the high number of selling points has restricted success.

An alternative marketing strategy is the use of generic marketing campaigns to establish "salmon loyalty". Although the implementation of generic marketing campaigns would likely benefit the industry as a whole, many countries have chosen to market their salmon as a distinct product. The use of marketing slogans to differentiate products from different parts of the world and gill tags is now widespread in all the regions covered in this report. It can be expected that differentiation strategies will continue given the level of competitiveness in the world market.

Marketing Structures

Some of the major factors which will affect the relative performance of the marketing activities of any country will be:

- the number of selling points in the industry - a reduction in the number of selling points in the industry facilitates proactive marketing and may also give producers greater control over product price; and
- level of development of cooperatives or industry organizations.

In Western Canada, marketing structures remain relatively undeveloped compared to other salmon producing countries. The relative number of selling points remains substantial as compared with Scotland and Norway. This makes the individual producer in British Columbia more vulnerable to buyers' demands. Equally, there has, as yet, been relatively little industry cooperation in developing structures to serve all salmon producers in the province. The B.C. Salmon Farmers Association has been proactive in coordinating industry activities but lack of funding has prevented the association from undertaking marketing and other activities. This contrasts strongly with the position in Norway where marketing is highly structured and selling permits are restricted by the government.

Effort is being placed on developing a generic marketing campaign in order to make the customer more aware of the advantages of the British Columbia product and more likely to buy farmed salmon from British Columbia. However, the following chart demonstrates that currently, marketing expenditure in Western Canada is considerably below that of other countries:

Table 20

Comparative Marketing Expenditure
in Norway, Scotland, British Columbia and Chile
1989

	$ millions	% of Sales Revenue
Norwegian Salmon Farmers Association	14.6	1.5
Scottish Salmon Board	6.3	1.5
B.C. Salmon Farmers Association	0.31	0.3
Chilean Salmon Farmers Association	1.8	2.8

Note: Based on a 1989 exchange rate of $US 1 = $1.1842

Source: Industry Trade Associations

The Canadian salmon farming industries have a great advantage in their proximity to a market with extremely high potential for development: the US. This remains one of the most undeveloped markets in the world in comparison with Japan and Europe. In comparison, the Norwegians and the Scottish sell primarily to relatively developed markets with less potential for expansion and are faced with significant transportation costs should attempts be made to market extensively in the US. Chile has substantially lower costs of production and as it has begun to sell its product on the US market, constitutes the main competition to Canadian producers in the US. Given this competition, it is obvious that considerable effort in initiating and expanding marketing campaigns in the US and to increasing funding to marketing could reap considerable benefits.

The lack of action in implementing a marketing strategy in British Columbia is a function of the youth of the industry. Advances are already being made on this front and , as the industry develops, it can be expected that further advances will be made and problems eliminated. The same is true of the industry in Eastern Canada. Here, the industry has remained so small in relative terms that demand outstripped supply. Furthermore, marketing to the US has been carried out in a fragmented way and the number of selling points exceeds that necessary for the size of the industry. With increased pressures on world markets and a larger industry, the need for a modern and concerted marketing campaign has become evident. This is particularly so given the proximity of the Eastern Canada industry to the substantial market of the US and the need to establish a market niche for East Coast

Canadian salmon. Bodies are being established in New Brunswick which are beginning to look at product marketing strategies.

Economic Performance

This section summarizes differences in production and capital costs faced in various producing nations.

Costs of production

Great care must be taken in attempting to make international comparisons of costs of production because of the difficulty of ensuring that the cost estimates employed are completely comparable. For example, it would not be instructive to compare costs FOB in one country with costs minus transportation in another. Costs may be affected by short-term fluctuations in capacity utilization or input costs. This section provides some comparisons which can act as indicators of proportional levels of unit costs in different operating areas, but does not attempt to be definitive.

Feed and Smolt Costs

Costs of production in salmon farming will depend, among other things, upon the following factors:

- salmon growth rates;
- feed prices;
- food conversion ratios;
- mortality rates; and
- processing and transportation costs.

These factors differ from country to country but certain general lessons can be learned.

Atlantic salmon farming countries are likely to have a relative advantage in production costs compared to Pacific salmon farmers. Salmon growth rates and feed conversion ratios for Atlantics are substantially better than those for Pacific salmon. Atlantic farmers would tend to experience lower feed costs relative to output volumes and, as these comprise the largest component of production costs, the relative unit production cost for Atlantic salmon is reduced. An analysis of unit costs of production for Atlantic salmon producers in Norway and Scotland demonstrates this point. Research and development has also shown that Atlantic salmon have considerably lower post-smoltification mortality rates than do Pacifics. However, mortality is not merely a function of species but also the environment in which the salmon are being farmed: care must therefore be taken in drawing conclusions concerning mortality rates by species and the general effect of these on unit costs of production. In

Scotland for example, Atlantic salmon are farmed in all areas but the mortality rate of smolts in the Mainland area is considerably higher than that in the Shetlands.

Growth rates are also important. The higher growth rate of the Atlantic salmon allows a larger product to be marketed and a more substantial margin to be made. It also reduces the relative feed cost per unit of product marketed.

Similarly, the same factors (growth rates and feed conversion ratios) ensure that smolt costs are reduced as a proportion of unit production costs. As a result, though Atlantic smolts cost considerably more than Pacific salmon smolts (smolt costs for Atlantic farmers can comprise some 20-25% of total costs as compared with 5-10% for Pacific) the cost of smolts per unit of product for Atlantics does not exceed Pacifics and can fall below it.

Given the above, salmon farmers on the West coast face a comparative disadvantage in production costs as long as production is concentrated in Pacific salmon. The unit costs of production presented in this report tend to bear this out. In contrast, the East coast industry has concentrated on Atlantic salmon and has therefore been able to take advantage of the production cost advantages of that species.

Transportation, Processing and Marketing

Transportation (costs related to the movement of the product from the site to the processor), processing and marketing also comprise a substantial part of the cost of production, reaching 30% in some cases. The actual proportion of total costs represented by these factors will depend on:

- the distance the fish is transported prior to processing;
- whether the salmon is live-hauled or dead-hauled to processing plants;
- the existence of centralized processing units; and
- whether marketing is carried out by the producer or a central marketing body.

The cost schedules produced in this report suggest that transportation, processing and marketing costs in British Columbia are considerably higher than elsewhere in the world. Some of the reasons for this might be:

- that most farmed salmon in British Columbia is transported to the Lower Mainland for processing;
- salmon tend to be live-hauled rather than dead-hauled to processing plants, primarily because of government restrictions on on-site processing making transportation costs to processing plants considerably greater than in Scotland and other regions; and
- there is no central marketing agency in British Columbia, unlike Norway, and as a result, the producer is faced with higher marketing costs.

Information available and presented in this report suggests that the cost of transportation, processing and marketing is also substantial in Eastern Canada. However, the figures presented here do not break this down as a separate cost and are included in "Other Costs". It is therefore assumed that actual transportation, processing and marketing costs are somewhat lower than the figures in this report suggest. The lack of information in this area makes it difficult to draw conclusions concerning transportation, marketing and processing costs in Eastern Canada.

Labour

There is a wide variation in labour costs between countries. In comparative terms, it appears that Western Canada performs well in this context, having lower costs than both Norway and Scotland. Eastern Canada, appears to have some of the highest labour costs, exceeding those even in Norway. However, the data for Eastern Canada should be treated with caution, since it is not a particularly high-wage region and the labour figures presented include a larger number of factors than those for other countries.

It would normally be expected that labour costs in British Columbia would be higher than in Eastern Canada because of the use of two crews at many sites, labour shortages, higher wage rates and unionization.

The importance of keeping labour costs down is demonstrated in Chile, which has some of the lowest labour costs in the world. In Chile, the low cost of labour has encouraged the industry to be labour-intensive. This has enabled producers to expand by concentrating on a relatively inexpensive resource, avoiding the large capital investment required in Western Canada.

Summary

The following table gives an indication of comparative costs of production. Caution must be taken in drawing conclusions from this table and it is presented here merely to illustrate in very broad terms, the points made in the section above. For this reason, actual costs are not represented: the distribution of costs between the major factors of production is shown instead.

Table 21

Comparison of Major Production Costs
(FOB First Selling Point)
Percent

	Western Canada (1989)	**Eastern Canada (1989)**	**Norway (1990)**	**Scotland (1988/89)**	**Chile (1987)**
Feed	45 %	38 %	44 %	31 %	38 %
Smolts	5	23	15	22	6
Transportation, processing, marketing	28	25 (1)	11	17	16
Labour	8	14	9	15	3
Other	14	-	21	15	37
	100 %	100 %	100 %(2)	100 %	100 %

Notes: The table is a summary of information presented in this report and should not be used to draw general conclusions about comparative costs of production.

(1) Includes all other costs of production

Capital costs

It is difficult to draw conclusions from a comparison of the capital cost structures in other countries because of widely different operating conditions faced by producers in each country. Capital costs are dependent upon the following factors:

- firm size;
- levels of integration in the industry;
- the age of the company and the industry as a whole;
- the performance of the industry; and
- exchange rates.

In Western Canada, capital costs have been reduced recently by the spate of receiverships and the availability of inexpensive capital items on the market. However, this is a temporary position which is not faced by producers in any other country. Similarly, the industry in Western Canada is new, with a very different structure from any other country and it can therefore be expected that costs will differ. Furthermore, as the infrastructure to serve the British Columbia industry is still developing, capital costs will also include some infrastructural investments which would not be included in Norway or Scotland . For these reasons it is neither sensible nor instructive to draw from comparisons of capital costs.

However, one general lesson can be learned from an examination of capital costs: that only lean firms, operating on very low capital budgets can survive in the current market climate. In Chile, the low price of labour has encouraged labour-intensive development of the industry. This has, in turn, kept the debt levels of producers down as less equipment has to be purchased and has thus made producers less vulnerable to the cash flow problems resulting from shifts in the world price for salmon, and from recurring interest payments on loans for capital expansion.

Financing

The amount and type of finance available for salmon farming operations differs substantially between countries and between the East and West Coasts of Canada. On the East coast, commercial banks have been relatively supportive of the industry, providing both operating loans and longer-term capital financing. Similarly, government financing has been high. In contrast, Canadian commercial bank loans on the West coast have been virtually non-existent, both for operating and capital costs. The availability of finance on the West Coast is also poor in comparison with Norway, Scotland and Chile where both public and private sources of funds are available.

Foreign investment in the salmon industry has been substantial in all countries except Norway: it has come primarily from Norway although in Chile, Scottish and Japanese companies have also begun to invest. However, the timing and effect of this funding has differed by country. In Scotland, the salmon farming industry was initially started by indigenous companies and Norwegian investment arrived at later date. It acted to expand and develop and existing industry based on local knowledge and experience. In contrast, Norwegian investment in Canada and particularly in the West, created the initial impetus for the development of the industry before local producers had established themselves.

An important observation in this area concerns debt-equity ratios which are an indication of the financial strength of the industry as a whole. Scotland has maintained a relatively low ratio of 1:1. The ratio in Norway is much higher at 4:1. In comparison, the debt-equity ratio in Western Canada has been very high as a result of the nature of investment in the industry and the tendency to develop highly capital intensive farms (aggregate figures for Eastern Canada are not available). This has caused severe problems in the industry in the face of decreasing prices and a squeeze in the margins of operators in their initial start-up phase. The situation can be contrasted with Chile where, because of labour-intensive expansion, the relative debt load of most operators is low compared with Western Canada.

Conclusions

The following conclusions are derived from the material presented in the International Comparisons section of the report and should be read in this context. The points made here are set in the context of a rapidly growing industry which, as a result of its growth, is experiencing specific problems which differ in degree and nature between countries and provinces. The industry will continue to grow in the future and the existing problems should therefore be identified and resolved in order to enhance the Canadian industry's long term financial performance.

Industry Structure

The experience presented in this report appears to show that smaller operations are often more efficient than large ones. However, operators can benefit from vertical integration, at least in terms of security of supply. In this context, the following observations can be made:

- In comparison with salmon farming industries elsewhere in the world, the structure of the salmon farming industry in Western Canada appears to be heavily concentrated (in terms of numbers of operators) at the production level and this concentration is increasing.
- On the other hand the degree to which the industry has become vertically integrated has allowed the industry to reap some benefits from economies of scale which have benefitted the industry.
- In contrast, Eastern Canada has experienced less rapid growth and concentration and is therefore still dominated by the smaller producer. However, there appears to be some movement towards increased concentration as evidenced by the purchase of a major US producer in Fall 1990. The industry, though considerably smaller than that in the West, has also been able to achieve economies of scale as a result of cooperation between producers on various functions.

Commercial Financing

Commercial lending can play an important role in the establishment and success of the salmon farming industry as shown by the Norwegian experience. The following conclusions can be drawn in relation to the two producing areas of Canada:

- Indigenous banks have been reluctant to lend to salmon farming operations in British Columbia. One of the main reasons for this is the use of a definition of assets which excludes fish stocks. The industry has therefore been forced to rely on finance from offshore banks (mainly Norwegian).
- In Eastern Canada, indigenous banks have been far more supportive of the new industry and have provided significant start-up and operating finance to salmon farm operations.
- Further research is required to explain the differences in lending practices on the two coasts.

Government

The government, through the provision of financial support and a supportive regulatory environment, has been instrumental in the successful and sustainable development of the salmon farming industry in other countries. In Norway and Scotland, the government has played a crucial role in regulating the industry and in determining its shape and nature. In these countries, the government has also provided significant financial support to facilitate the development and growth of salmon farming. In contrast, the Chilean government has imposed very few regulatory restrictions and has allowed the industry to develop freely. On the other hand, they have played a role in providing research and development and financial support to salmon farmers. The approaches taken on the two coasts of Canada are explained below:

- On the East coast, the government, at both the provincial and federal level, has been careful to support the industry financially through grants and loan guarantees. It has also ensured that its growth has been sustainable and orderly using regulation to limit the size and nature of operations. This task has been made easier by the physical limitation of potential site availability Though regulation is considered to be relatively stringent, it is not perceived to have inhibited the growth of the industry to any great degree but has ensured the orderly and sustainable growth of salmon farming.
- In strong contrast, the provincial government in the West has not provided the same support in terms of both finance and regulation. Financial support from the province has been less pervasive than that provided in the East. Regulations are perceived by industry to have been excessive because they have tended not to direct and monitor industry growth to ensure stable and sustainable growth but to limit the independence of the producer at the operational level. At the federal level, regulations in the West are similar to those in the East. Financial support, however, has differed: the Western Diversification Fund has generally been far less supportive of the salmon aquaculture industry than has the Atlantic Canada Opportunities Agency.

The Product and Production Characteristics

When salmon prices are high, producers can be less concerned with the margin between unit cost of production and selling price. However, given the recent glut of salmon on the world market and the resulting fall in price, only producers with low costs, producing a product which will sell in the upper price brackets will operate profitably. With producers being squeezed by decreasing prices, costs of production and production characteristics (such as feed conversion ratios, rate of growth, and size of fish at sale) must be optimized.

- This has been easier to achieve on the East coast where Atlantic salmon is the major species. This has led to significant feed conversion and growth rate advantages which more than outweigh the higher costs associated with Atlantic smolt purchase. The final product can be marketed sooner and at a higher price (as a result of its larger size) thus increasing the revenue earned by the producer. Furthermore, producers have been able to take advantage of the considerable amount of research and development experience which has been amassed on the culture of the Atlantic species.

- The industry on the West coast has some major problems in containing costs:
  - chinook salmon, the major species farmed, have lower feed conversion ratios and slower growth rates;
  - post-harvest costs are kept high by the distance fish have to be transported and the fact that they are live-hauled; and
  - there is relatively little known about the culture of Pacific salmon. Consequently, smaller fish are eventually marketed in lower price brackets and margins are therefore doubly squeezed by higher costs and lower profits. Producers in the West have been prevented from farming Atlantics by government regulations which have controlled the introduction of a new species into British Columbia waters. However, more recently, these regulations have been amended and Atlantic production has been increasing. This trend is likely to continue in the future.

Operating and Capital Costs

Not much can be learned from a direct comparison of operating and capital costs: these will vary by region according to the nature of the industry in each. However, the following descriptive differences can be noted:

- Smolt costs are much higher in the East than the West because of the species cultivated in each.
- Feed costs constitute a higher proportion of total costs in the West, probably as a result of lower feed conversion ratios for Pacific salmon.
- Post harvest costs are considerably higher than those in other producing regions (primarily because of the large distance fish are live-hauled) and comprise a significant proportion of operating costs.

In current world markets, it is crucial that producers be able to maximise their margins. This has proved more difficult in British Columbia than in Eastern Canada because of concentration on Pacific species and problems with keeping feed and post harvest costs to a minimum.

Marketing

In an increasingly competitive market, product marketing is very important. Study of both Norway and Scotland has shown that, even in relatively saturated markets, consumption and sales can be increased by adding value to products produced and brand marketing.

- Neither the West nor the East coast industry has developed and acted upon a generic marketing campaign to ensure a market niche for Atlantic or Pacific Canadian salmon. On both coasts, this is now something which is being developed and is essential in a world of increasing competition.
- Efforts are being made on both coasts to develop value added products which can broaden markets shares and increase margins. In comparison to the products being developed elsewhere, however, the developments in Canada are relatively new.

In conclusion, it appears that the financial structure and performance of the industry in Eastern Canada has been more controlled and sustainable than that in the West. Though production levels remain below those in the West, the structure of the industry is stronger and the performance of individual producers has been superior. The main reasons for this are: carefully monitored and regulated growth, commercial and governmental financial support to a new industry, cooperation on the part of producers to achieve more efficiencies and a concentration on Atlantic Salmon.

Western Canada has grown too rapidly and in an uncontrolled fashion. Consequently, there are a number of structural and financial problems in the industry which will need to be solved over the next few years. However, the industries on the two coasts also have substantial similarities which, in the longer term, will help to strengthen their position: both are located close to a major US market with significant potential for expansion, they have suitable sites and water quality for salmon farming and both are developing generic marketing campaigns to ensure a niche for their product in world markets.

Appendices

1-1 Worldwide Production of Farmed Salmon, 1981 - 1989

1-2 Selected World Salmon Price Ranges 1987 - 1990

2 Farmed Salmon Production in British Columbia, 1980 - 1990

3 Farmed Salmon Production in New Brunswick, 1979 - 1990

4 Farmed Salmon Production in Nova Scotia, 1986 - 1989

5 Farmed Salmon Production in Norway, 1980 - 1989

6 Average Costs of Production in Norway

7 Farmed Salmon Production in Chile, 1981 - 1989

8 Projected Output in Chile, 1989 - 1993

9 Farmed Salmon Production in Scotland, 1980 - 1989

Appendix 1-1

Worldwide Production of Farmed Salmon
1981-1989
(tonnes)

A. Farmed Atlantic Salmon

	1981	1982	1983	1984	1985	1986	1987	1988	1989
Norway	8,910	10,266	17,016	22,300	28,655	45,675	47,417	80,300	117,000
Scotland	1,000	2,100	2,536	3,912	6,921	10,300	12,600	17,600	28,500
Ireland	35	103	257	385	650	650	2,500	4,200	6,200
Faroe Islands	100	130	160	300	450	600	2,500	3,400	6,000*
Iceland	20	30	50	70	90	100	1,000	1,300	1,800*
Other	60	80	100	75	300	390	400	1,990	3,220*
Eastern Canada	28	48	126	163	188	297	1,300	3,300	4,600
Total	10,153	12,757	20,245	27,205	37,254	58,012	67,717	112,090	167,320

B. Farmed Coho and Chinook

	1981	1982	1983	1984	1985	1986	1987	1988	1989
B.C.	176	273	128	107	120	397	1,362	6,590	12,400
Chile	60	80	100	270	870	1,000	1,600	3,100	6,680
Western U.S.	450	680	900	1,176	1,257	1,507	2,000	1,900	4,000
Japan	1,150	2,122	2,760	5,049	6,430	7,220	12,000	14,060	17,100
Other	60	80	80	90	100	180	200	200	200*
New Zealand	2	5	10	20	500	500	1,500	1,650	2,000*
Total	1,898	3,240	3,978	6,712	9,277	10,804	18,500	27,500	42,380

Note: * Preliminary estimates

Source: Price Waterhouse, "Long Term Production Outlook for the Canadian Aquaculture Industry", July 1990

Selected World Salmon Price Ranges(1)
1987 - 1990
$US/lb.

A. 4-6 lb Salmon

	1987	1988	1989	1990
Norwegian(2) Atlantics	4.2 (Feb) - 5.3 (June)	4.1 (Dec) - 5.2 (June)	3.0 (Dec) - 4.0 (Feb)	3.5 (Jan) - 4.2 (Sept)
Chilean coho(2)	3.3 (Jan) - 4.4. (Dec)	3.6 (Feb) - 4.2 (Jan)	3.6 (Jan-Mar)	3.0 (Jan-Mar)
B.C. chinook(3)	3.9 (Mar) - 4.5 (Apr)	3.4 (Oct) - 4.5 (Apr)	2.4 (Sept) - 3.7 (Jan)	2.5 (Aug) - 3.1 (May)

B. 6-9 lb Salmon

	1987	1988	1989	1990
Norwegian(2) Atlantic	N/A	N/A	3.4 (Dec) - 4.09 (Jan)	3.8 (Jan) - 4.5 (Sept)
Chilean Atlantics(2)	N/A	N/A	N/A	3.5 (Nov) - 4.1 (Sept)
B.C. Kings(3)	N/A	N/A	2.7 (June) - 4.1 (Jan)	3.0 (Aug) - 3.7 (Apr)
Canadian(3) Atlantics	N/A	N/A	3.1 (Dec) - 4.2 (Jan)	3.5 (Jan) - 4.1 (Sept)

Source: Urner-Barry Seafood

Notes:

(1) Based on average monthly first receiver prices, valued at current $US values.

(2) FOB Mid Atlantic US

(3) FOB Seattle

N/A Not available.
Consistent salmon price data by region are not readily available and the above data are based on incomplete monthly estimates from the B.C. Salmon Farmers Association and Urner-Barry Seafood.

Farmed Salmon Production in British Columbia
1980 - 1990

Year	Number of Operating Sites[1]	Production: Volume (Tonnes)	Production: Value ($000's Farm Gate Value)
1980	N/A	157	898
1981	4	176	985
1982	5	273	1,136
1983	8	128 (2)	708
1984	10	107	702
1985	37	120	820
1986	69	397	2,900
1987	118	1,362	10,280
1988	135	6,590	39,080
1989	135	12,400	85,000
1990 (4)	106 (3)	13,000	89,000

Notes:

(1) Licensed operations with fish in the water.

(2) The largest producer ceased production in 1982, resulting in a production decline in 1983.

(3) 52 companies operating in June 1990.

(4) Estimated

Source: Ministry of Agriculture and Fisheries, Victoria, B.C.; and B.C. Salmon Farmers Association.

Farmed Salmon Production In New Brunswick

1979 - 1990

Year	Number of Farms	Production Volume (Tonnes)	Value ($000's Farm Gate Value)
1979	1	6	$ 50
1980	2	11	80
1981	2	21	160
1982	4	38	320
1983	4	68	680
1984	5	223	2,570
1985	18	350	4,200
1986	28	636	8,060
1987	33	1,318	18,000
1988	36	3,250	42,900
1989	49	4,500	42,000
1990 (1)	52	8,181	80,900

Note:

(1) Estimated

Source: N.B. Department of Fisheries and Aquaculture

Farmed Salmon Production in Nova Scotia

1986 - 1989

Year	**Production** **Volume** (Tonnes)	**Value** ($000's Farm Gate Value)
1986	29	n/a
1987	29	289
1988	27	310
1989	145	1,088
1990	300	n/a

Source: Nova Scotia Department of Fisheries

Farmed Salmon Production in Norway

1980 - 1989

	No. of Farms	Production Volumes (Tonnes)	 Average per Farm[(1)]
1980	307	7,513	24.4
1981	316	12,907	40.8
1982	387	14,956	38.6
1983	411	22,109	53.8
1984	483	25,936	53.7
1985	559	33,796	60.4
1986	714	49,985	69.9
1987	747	56,204	75.2
1988	786	89,696	114.1
1989	N/A	117,000	N/A

Notes:

(1) Includes 4-6,000 tonnes trout

Source: Fiskeoppdretternes Salgslag, Bjorndal, (1987)

Average Costs of Production In Norway

	Nkr	$	% Cost
Smolts	9.42	1.68	23
Feed	11.38	2.02	28
Insurance	1.64	.29	4
Wages	5.47	.97	13
Total Variable costs	27.91	4.96	68
Fixed operating costs	4.93	.88	12
Depreciation	1.56	.28	4
Interest(1)	6.39	1.14	16
Total	40.79	7.26	100

Notes:

(1) Interest includes interest on debt and calculated interest on equity

The information in this table is based on the following:

• Average production quantity (tonnes)	188.70
• Workers per farm	2.90
• Sample size	281

Source: Directorate of Fisheries, Bergen, Norway: Profitability Study of Fish Farms (1988)

Farmed Salmon Production in Chile

1981 - 1989

Year	Production (Tonnes)
1981	70
1982	80
1983	94
1984	104
1985 - 86	1,200
1986 - 87	1,753
1987 - 88	3,500
1988 - 89	5,500
1989 - 90 (1)	14,700 (2)

Notes:

(1) Forecast

(2) Includes 4,000 tonnes of Atlantic salmon

Source: Trond Bjorndal, The Economics of Salmon Aquaculture

Appendix 8

Projected Output in Chile
1989 - 1993

	1989	1990	1991	1992	1993
Salmon Production (in tonnes)					
Atlantic	1,770	4,900	6,000	7,000	8,000
Pacific	6,825	8,500	12,000	14,000	15,000
Smolt Production (in millions)					
Atlantic	2.8	4.0	5.0	5.6	6.0
Pacific	6.9	10.8	11.6	12.5	13.0

Source: International Salmon Farmers' Association (March 1990)

Appendix 9

Farmed Salmon Production in Scotland
1980 - 1989

Year	Production (tonnes)
1980	598
1981	1,133
1982	2,152
1983	2,536
1984	3,901
1985	6,921
1986	10,300
1987	12,721
1988	17,951
1989	28,553
1990(1)	34,000

Note:

(1) Forecast

Source: Department of Agriculture and Fisheries of Scotland

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